



# **NAVAL POSTGRADUATE SCHOOL**

**MONTEREY, CALIFORNIA**

## **THESIS**

**AN OPERATIONAL MANPOWER ANALYSIS OF THE  
RQ-8 FIRE SCOUT VERTICAL TAKE-OFF UNMANNED  
AERIAL VEHICLE (VTUAV)**

by

Matthew C. Stracker

September 2007

Thesis Advisor:  
Second Reader:

Bill Hatch  
Ben Roberts

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**AN OPERATIONAL MANPOWER ANALYSIS OF THE RQ-8 FIRE SCOUT  
VERTICAL TAKE-OFF UNMANNED AERIAL VEHICLE (VTUAV)**

Matthew C. Stracker  
Lieutenant Commander, United States Navy  
B.A., The Ohio State University, 1996

Submitted in partial fulfillment of the  
requirements for the degree of

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September 2007**

Author: Matthew C. Stracker

Approved by: Professor Bill Hatch  
Thesis Advisor

Dr. Ben Roberts  
Second Reader

Robert N. Beck  
Dean, Graduate School of Business and Public Policy

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## **ABSTRACT**

In August of 2001, the Secretary of the Navy announced the Navy would expand the work and experimentation in unmanned vehicle systems. After the events of September 11 this was accelerated with the increased urgency to combat terrorism and asymmetric threats. The U.S. Navy is currently undergoing testing and evaluation of the Fire Scout Vertical Take-Off Unmanned Aerial Vehicle (VTUAV) and its integration into the fleet.

An in depth analysis of the Fire Scout's manpower requirements is necessary as part of total force integration. At the present time, the Navy only utilizes aviation ratings by requirement and assignment as unmanned aerial system operators, unlike the Army and Marine Corps. Therefore, the Littoral Combat Ship manpower requirements exceed the Navy's target of 25 persons for the combined RQ-8B and SH-60 air detachment. Analysis shows a possible remedy to this problem is to allow non-aviation ratings the opportunity to operate the Fire Scout. This change in policy and occupational standards would generate greater operational capability and personnel flexibility for this newly acquired air ship and surface platform.

Specifically, occupational research showed the Aviation Administrationman (AZ) rating is no more qualified to operate a Fire Scout VTUAV than the Operations Specialist (OS) rating. In fact, it can be argued that an OS is better qualified according to occupational standards to operate the Fire Scout. Therefore, one of the recommendations of this research is to add Operational Specialist as a source rating to NECs 8363 and 8364 immediately.

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

(AOR)	Area of Responsibility
(AQD)	Additional Qualification Designator
(ASTAC)	Anti-Submarine Tactical Action Coordinator
(ASW)	Anti-Submarine Warfare
(AVGAS)	Aviation Gasoline
(AVO)	Air Vehicle Operator
(BAMS)	Broad Area Maritime Surveillance
(BDA)	Battle Damage Assessment
(CIC)	Combat Information Center
(DOD)	Department of Defense
(FAA)	Federal Aviation Administration
(FMP)	Focused Mission Package
(GAO)	Government Accounting Office
(GCS)	Ground Control Station
(GWOT)	Global War on Terrorism
(HSI)	Human Systems Integration
(HSL)	Helicopter Anti-Submarine Squadron Light
(IDTC)	Inter-Deployment Training Cycle
(IED)	Improvised Explosive Device
(IFT)	Initial Flight Training
(IP)	Internal Pilot
(IQT)	Initial Qualification Training

(ISR)	Intelligence, Surveillance and Reconnaissance
(KSA)	Knowledge, Skills and Abilities
(LCS)	Littoral Combat Ship
(MAGTF)	Marine Air Ground Task Force
(MAV)	Micro Unmanned Aerial Vehicle
(MC)	Mission Commander
(MIO)	Maritime Interdiction Operations
(MIW)	Mine Warfare
(MMF)	Mobile Maintenance Facility
(MMP)	Modular Mission Payload
(MOGAS)	Motor Gasoline
(MOS)	Military Occupation Specialty
(MPO)	Mission Payload Operator
(MUAV)	Mini Unmanned Aerial Vehicle
(NEC)	Navy Enlisted Classification
(NEOCS)	Navy Enlisted Occupational Classification System
(NTSP)	Navy Training System Plan
(OEF)	Operation Enduring Freedom
(OIF)	Operation Iraqi Freedom
(OOD)	Officer of the Deck
(PCS)	Portable Control Station
(PO)	Payload Operator
(RATO)	Rocket Assisted Take Off
(RDT)	Remote Data Terminal

(RRS)	Remote Receiving Station
(RVT)	Remote Video Terminal
(SA)	Situational Awareness
(SMD)	Ship Manning Document
(SOF)	Special Operations Forces
(SPARS)	Shipboard Pioneer Arrestment and Recovery System
(SUPT)	Specialized Undergraduate Pilot Training
(SUW)	Surface Warfare
(SWO)	Surface Warfare Officer
(TA)	Target Acquisition
(TAO)	Tactical Action Officer
(TCS)	Tactical Control System
(TCU)	Tracking Communication Unit
(UAS)	Unmanned Aerial System
(UAV)	Unmanned Aerial Vehicle
(UCARS)	UAV Common Automatic Recovery System
(VO)	Vehicle Operator
(VTUAV)	Vertical Take Off Unmanned Aerial Vehicle

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# **I. INTRODUCTION**

## **A. AREA OF RESEARCH**

This research will analyze the manpower requirements and manning implications for operating Unmanned Aerial Vehicles (UAVs) aboard Navy ships, specifically focusing on the RQ-8 Fire Scout and its manpower requirements for the Littoral Combat Ship (LCS). The research will examine a broad spectrum of UAV operations and employment by the U.S. Navy. The research will include a review of manpower requirements for operating and maintaining other U.S. military UAVs. An analysis of the occupational standards required for operating UAV systems in support of a variety of missions and evolutions will be conducted. The objective of this research is to provide the U.S. Navy a consolidated framework for understanding UAV watch team requirements as well as make manpower recommendations for Fire Scout aboard the LCS.

## **B. RESEARCH QUESTIONS**

### **1. Primary Questions**

- What is the composition of UAV watch teams?
- What are the existing operations and future operations of Naval VTUAVs?
- What current manpower requirements support Fire Scout VTUAV Mission Commanders, Payload Operators and Vehicle Operators?

### **2. Secondary Questions**

- What are the existing occupational standards for VTUAV and UAV operators in the U.S. Navy?

## C. DISCUSSION

Throughout Operation Enduring Freedom (OEF) and Operation Iraqi Freedom, (OIF) the Unmanned Aerial Vehicle (UAV) has proven to be an exceptional asset to combatant commanders. During OEF, the Global Hawk UAV provided commanders over 17,000 near-real-time, high-resolution, reconnaissance images and logged more than 1,200 combat hours.<sup>1</sup> UAVs have also been indispensable at engaging the enemy directly. The MQ-1B Predator UAV in March of 2006 engaged and killed three Iraqi insurgents installing an Improvised Explosive Device (IED) outside Balad Air Base. The Predator engaged the enemy with the AGM-114 Hellfire missile.<sup>2</sup> These examples illustrate a small fraction of the capabilities UAVs bring to U.S. operational commanders. The Government Accounting Office (GAO) summarized it best by stating, “Moreover, UAVs are no longer an additional ‘nice to have’ capability; they are becoming essential to the services’ ability to conduct modern warfare.”<sup>3</sup>

In August of 2001, the Secretary of the Navy announced the Navy’s desire to expand the work and experimentation with unmanned aerial vehicle systems. After the events of September 11, this was accelerated, with the increased urgency to combat terrorism globally. Since that time, UAV experimentation, development and utilization have grown substantially. These systems, however, are relatively still in their infancy with the U.S. Navy.

A consolidated list of manpower requirements is necessary to examine how to integrate UAVs in the fleet. The RQ-2 Pioneer, in operation since the late 1980s, and more recently the new RQ-8 Fire Scout will be used to examine occupational standards and rate/ratings to determine manpower requirements. This analysis will provide an

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<sup>1</sup> Northrop Grumman, HALE Program Overview History and Accomplishments. [accessed 15 March 2007] available from World Wide Web @ <http://www.northropgrumman.com/unmanned/globalhawk/overview.html>.

<sup>2</sup> U.S. Central Command, “Air Force Predator UAV Engages Insurgents Placing IED.” [accessed 12 April 2007] available from World Wide Web @ <http://www.centcom.mil/sites/uscentcom2/Lists/Press%20Releases/DispForm.aspx?ID=2845>.

<sup>3</sup> U.S. General Accounting Office, Major Management Issues Facing DOD’s Development and Fielding Efforts. [accessed 29 March 2007] available from World Wide Web @ <http://gao.gov/cgi-bin/getrpt?GAO-04-530T>.

overview as well as recommendations regarding manpower requirements for the naval VTUAV, specifically for the RQ-8 Fire Scout aboard the Littoral Combat Ship (LCS).

#### **D. BENEFITS OF THE STUDY**

The study of UAV manpower requirements within the U.S Navy is a critical component in the fleet implementation of this new technology. Without a thorough understanding of the workload necessary to operate UAVs (specifically, the RQ-8 Fire Scout) in a maritime environment, the U.S. Navy will find difficulty in properly integrating this new system aboard various platforms such as the LCS.

#### **E. SCOPE**

The scope will include: (1) an examination of all UAV fleet lessons learned messages; (2) an evaluation of Navy Enlisted Classification (NEC) for Ship Manpower Documents (SMD) for LCS, DDG-51 and CG-52 platforms regarding air and UAV operations; (3) an analysis of U.S. Navy training and schools for the operation and maintenance for UAVs; (4) identification of manning requirements for the RQ-8 Fire Scout and the new Littoral Combat Ship; and (5) review of Navy Training System Plans.

#### **F. METHODOLOGY**

The methodology used in this thesis research will consist of the following steps:

- Conduct a literature search of books, magazine articles, Internet search, CD-ROM systems, and other reference information resources.
- Review existing LCS manpower requirements.
- Review all pertinent UAV documents to include CONOPS from the RQ-2 Pioneer and the RQ-8 Fire Scout.
- Combine rating recommendations and CONOPS with occupational standards to identify manpower requirements.

## **G. THESIS ORGANIZATION**

**Chapter I: *INTRODUCTION*:** Establishes the primary purpose of the thesis and discusses the importance of UAVs to the U.S. military. Primary and secondary questions are established.

**Chapter II: *OPERATIONAL EMPLOYMENT AND MANNING CONSIDERATIONS OF THE RQ-2 PIONEER AND THE RQ-7 SHADOW*:** Provides a brief history of UAVs in the U.S. military and discusses the operations and manpower requirements of the RQ-2 Pioneer and the RQ-7 Shadow.

**Chapter III: *OPERATIONAL EMPLOYMENT AND MANNING CONSIDERATIONS OF THE RQ-8 FIRE SCOUT AND THE LITTORAL COMBAT SHIP*:** This chapter discusses the general characteristics and operations of the Fire Scout and LCS, to include the manpower requirements for operating a Navy VTUAV.

**Chapter IV: *VTUAV OPERATORS AND MANNING IMPLICATOINS*:** Establishes a critique and consolidated discussion of the rates, ranks as well as the occupational standards required for operating the Navy VTUAV.

**Chapter V: *SUMMARY, CONCLUSIONS AND RECOMMENDATIONS*:** This chapter will provide a summary of findings and present recommendations to the U.S. Navy on potential improvements to VTUAV manpower requirements determination and watch standing procedures.



## **II. OPERATIONAL EMPLOYMENT AND MANNING CONSIDERATIONS OF THE RQ-2 PIONEER AND THE RQ-7 SHADOW**

### **A. INTRODUCTION AND OVERVIEW OF UAVS IN THE U.S. MILITARY**

#### **1. Historical Background**

The use of Unmanned Aerial Vehicles (UAVs) by the U.S. Military can be traced to as far back as the American Civil War. In February of 1863 a New Yorker named Charles Perley was awarded a patent for an unmanned aerial balloon that was designed to drop explosives when triggered by a crude timing device.<sup>4</sup> During World War I an Ohio man named Charles Kettering developed the “Kettering Bug”, a biplane designed for unmanned flight with the capability of delivering a 250 lb warhead. This particular UAV utilized a device that would count the number of propeller revolutions to estimate travel distance and at the appropriate time would cut fuel from the engine, thereby causing the aircraft to (hopefully) ram into its intended target.<sup>5</sup> Neither of these early prototypes was deployed in combat. Later, during World War II the Aphrodite Project would utilize bombers packed with explosives and crash them into specific targets. These aircraft were designed to be manned at take off and then radio controlled into their targets after the pilots parachuted to safety.<sup>6</sup> This program met little success and was cancelled but not before the death of President Kennedy’s oldest brother Navy LT Joseph Kennedy on one such mission. From the “Kettering Bug” to the use of unmanned planes packed with explosives the UAV has grown exponentially in both technology and military effectiveness. As a result the UAV has been involved in every recent major combat

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<sup>4</sup> Lexi Krock, Pre-Aviation UAVs Perley’s Aerial Bomber (USA). [accessed 1 May 2007] available from World Wide Web @ <http://www.pbs.org/wgbh/nova/spiesfly/uavs.html>.

<sup>5</sup> John DeGaspari, “Look, Ma No Pilot!” [accessed 10 July 2007] available from World Wide Web @ <http://www.memagazine.org/backissues/membersonly/nov03/features/lookma/lookma.html>.

<sup>6</sup> Pathfinder Air Development Centre Bulletin, Ancestors of the UAV. [accessed 10 July 2007] available from World Wide Web @ [http://www.defence.gov.au/raaf/AirPower/html/publications/pathfinder/2006/Pathfinder\\_41\\_Mar06.pdf](http://www.defence.gov.au/raaf/AirPower/html/publications/pathfinder/2006/Pathfinder_41_Mar06.pdf).

operation from Kosovo to the current conflicts in Iraq and Afghanistan. The Defense Science Board Study on Unmanned Aerial Vehicles and Uninhabited Combat Aerial Vehicles summarizes the current state of UAVs best by stating:

The benefits and promise offered by UAVs in surveillance, targeting and attack have captured the attention of senior military and civilian officials in the Defense Department (DOD), members of Congress, and the public alike. Indeed these recent combat operations appear to indicate that unmanned air systems have at last come of age.<sup>7</sup>

This explosion of development and proven operational effectiveness of the UAV has resulted in a multitude as well as variety of these platforms.

## **2. Types of UAVs**

Today there are hundreds of UAVs in the U.S. military, conducting a variety of missions from reconnaissance to neutralization of targets, and ranging from the size of a hawk to larger than a tactical fighter jet. The U.S. arsenal contains large UAVs like the RQ-4 Global Hawk (wingspan of over 116 feet) and the MQ-9 Predator (wingspan of sixty-six feet).<sup>8</sup> (Figures 2 and 3) The RQ-4 is designed to conduct missions like Broad Area Maritime Surveillance (BAMS) for the Navy and can fly at an altitude of 65,000 feet with a long range of 12,000 nautical miles. Both of these UAVs are high-endurance aircraft that have the ability to fly great distances and stay on station in excess of 24 hours. The U.S. also has Mini Unmanned Aerial Vehicles (M-UAV) like the Dragon Eye (wingspan of 4 feet) and Micro Unmanned Aerial Vehicles (MAV) such as the Wasp and Hornet which are much smaller. (Figures 1 and 4) MAVs are primarily designed for single-person operation and can fit in a soldier's backpack. The Dragon Eye is utilized primarily by the U.S. Marine Corps for troops at the platoon level for reconnaissance of the battlefield. The U.S. Military has a large variety of these Unmanned Aerial Systems (UAS), which have become indispensable to the battlefield commander.

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<sup>7</sup> Defense Science Board Study, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, Unmanned Aerial Vehicles and Uninhabited Combat Aerial Vehicles. [accessed 10 May 2007] available from World Wide Web @ <http://www.acq.osd.mil/dsb/reports/uav.pdf>.

<sup>8</sup> Office of the Secretary of Defense, Unmanned Aircraft Systems Roadmap 2005-2030. [accessed 11 April 2007] available from World Wide Web @ [http://www.fas.org/irp/program/collect/uav\\_roadmap2005.pdf](http://www.fas.org/irp/program/collect/uav_roadmap2005.pdf).



Figure 1. Marine and Dragon Eye UAV [From Jane's]<sup>9</sup>



Figure 2. RQ-4 Global Hawk [From Jane's]<sup>10</sup>

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<sup>9</sup> Jane's, Jane's Unmanned Aerial Vehicles and Targets. [accessed 10 April 2007] available from World Wide Web @ <http://juav.janes.com/public/juav/index.shtml>.

<sup>10</sup> Ibid.



Figure 3. MQ-9 Predator [From Jane's]<sup>11</sup>



Figure 4. Wasp MAV [From Jane's]<sup>12</sup>

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<sup>11</sup> Jane's, Jane's Unmanned Aerial Vehicles and Targets.

<sup>12</sup> Ibid.

### **3. Small-Sized Unmanned Aerial Vehicles**

This chapter will focus on small-sized Unmanned Aerial Vehicles, specifically the RQ-2 Pioneer, utilized by the Navy and Marine Corps as well as the Army's RQ-7 Shadow. The category of small UAV is rather broad and exists between the large, high-endurance UAV—like the RQ-4—and the MAVs. Bill Sweetman of the International Defence Review states it best, “Between these two extremes, the definition of different UAV classes is fluid and rapidly changing, as operators proliferate worldwide and build up hours at an unprecedented rate.”<sup>13</sup> There are several reasons for focusing on just these two specific platforms within such a broad and changing category. First, the RQ-8 Fire Scout vertical take-off unmanned aerial vehicle (VTUAV) will be replacing the RQ-2 Pioneer for the Navy and Marine Corps. Second, the Army RQ-7 Shadow is a very similar platform to the RQ-2 Pioneer and as a result can potentially provide additional insights for the Fire Scout. Another reason is that the Pioneer and Shadow have a large range of similar tactical missions, from reconnaissance to target acquisition, missions the Fire Scout will soon be tasked to assume. Put simply, it is best to start a manpower requirements study of the Fire Scout with the platform, or similar platforms, it was built to replace. Therefore, the study of the manning and missions of these platforms, Pioneer and Shadow, to date will provide the best foundation of how to properly implement and man the new RQ-8 Fire Scout VTUAV.

#### **B. THE U.S. NAVY AND MARINE CORPS RQ-2 PIONEER**

##### **1. General Description**

The RQ-2 Pioneer is a twin-tail, lightweight UAV with an airframe that is comprised of carbon-fiber composites. These composites consist of Kevlar, balsa wood, aluminum and fiberglass that contribute to the Pioneer's payload capacity.<sup>14</sup> The primary

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<sup>13</sup> International Defence Review, “Tactical UAVs: Redefining and Refining the Breed.” [accessed 11 May 2007] available from World Wide Web @ [http://www.janes.com/defence/air\\_forces/news/idr/idr050811\\_1\\_n.shtml](http://www.janes.com/defence/air_forces/news/idr/idr050811_1_n.shtml).

<sup>14</sup> Smithsonian National Air and Space Museum, Pioneer RQ-2A. [accessed 26 April 2007] available from World Wide Web @ <http://www.nasm.si.edu/research/aero/aircraft/pioneer.htm>.

payload is an electro-optical infrared sensor that enabled the Pioneer to perform various tasks from reconnaissance to naval gunfire support. The wings, tail and other components are detachable to facilitate ease of transfer between aircraft.<sup>15</sup> The Pioneer is designed to land on a tricycle landing gear on a runway when ashore or by flying into a net aboard ship. The U.S. Navy uses the Shipboard Pioneer Arrestment and Recovery System (SPARS) to land at sea. Put simply, this system is two poles holding a net on a ship's flight deck into which the RQ-2 is flown for recovery. Figure 5 shows the recovery of a Pioneer using this method. Also at sea the Pioneer is launched by a rocket booster, which is jettisoned after use.<sup>16</sup> This technique is known as the Rocket Assisted Take-Off Launch System (RATO). Figure 6 shows a Pioneer being launched at sea using this method. The Pioneer can also be launched from a Pneumatic Rail Launcher ashore if ground conditions are unprepared. The Pioneer has three versions: the RQ-2A, the RQ-2B and the RQ-2C. Each type of Pioneer has slightly different variations and upgrades to engines, avionics as well as payload. The Pioneer does not utilize JP-5 as its primary fuel source, unlike all other Navy aircraft. It uses 100-octane aviation gasoline (AVGAS) for its two-stroke engine. The RQ-2 was in service for the U.S. Navy from 1986 to 2002 when all remaining assets were transferred to the U.S. Marine Corps. Table 1 shows all the general characteristics of the RQ-2A Pioneer.

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<sup>15</sup> Jane's Unmanned Aerial Vehicles and Targets, AAI/IAI RQ-2 Pioneer. [accessed 10 April 2007] available from World Wide Web @ <http://juav.janes.com/public/juav/index.shtml>.

<sup>16</sup> Jane's Unmanned Aerial Vehicles and Targets, AAI/IAI RQ-2 Pioneer.





Figure 5. RQ-2 Pioneer SPARS Landing on LPD [From Global Security]<sup>17</sup>



Figure 6. RQ-2 Pioneer RATO Take Off [From Jane's]

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<sup>17</sup> Global Security, Pioneer Short Range (SR) UAV. [accessed 11 May 2007] available from World Wide Web @ <http://www.globalsecurity.org/intell/systems/pioneer.htm>.

Table 1. RQ-2A General Specifications [After NAVAIR]<sup>18</sup>

<b>Characteristics</b>		
<b>Weight</b>	Empty	276 lb
	Fuel Capacity	65 lb
	Sensor Payload (max)	75 lb
	Max Takeoff Wt	416 lb
<b>Dimensions</b>	Wing Span	17 ft 1 in
	Fuselage Length	9 ft 7 in
	Fuselage Width	1ft 4 in
	Wing Area	30.1 sq ft
<b>Propulsion</b>	Pusher-propeller driven two-stroke, twin-cylinder, rear mounted engine	
	Max Power	29 hp
<b>Performance</b>	Fuel Capacity	12.9 gallons of 100 octane AVGAS
	Altitude	15,000 ft
	Loiter Speed	59 mph
	Cruise Speed	74.5 mph
	Maximum Speed	109.4 mph
	Radius of Action	
	(nominal)	87 nm
	(maximum)	101 nm

## 2. Overview of Navy and Marine Corps Missions and Operations

The Pioneer UAV has served in the U.S. Navy aboard its Iowa Class battleships and LPD amphibious ships. It was first used operationally during Operation Desert Storm, where in 1991 twenty-seven Iraqis on Faylaka Island surrendered to a low-flying

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<sup>18</sup> NAVAIR, RQ-2 Pioneer Characteristics. [accessed 26 April 2007] available from World Wide Web @ [https://wrc.navair-rdte.navy.mil/warfighter\\_enc/aircraft/UAVs/pioneer.htm](https://wrc.navair-rdte.navy.mil/warfighter_enc/aircraft/UAVs/pioneer.htm).



Pioneer from the U.S.S. WISCONSIN (BB 64).<sup>19</sup> Battleships like the WISCONSIN utilized the Pioneer's electro-optical and infrared sensors to provide imagery for real-time artillery adjustment for their 16-inch guns, mine hunting, bomb damage assessment as well as reconnaissance.<sup>20</sup> The Pioneer was used by the Navy throughout the 1990s from Operation Continue Hope in Somalia to Operation Allied Force in Kosovo.

The U.S. Marine Corps primarily utilizes the Pioneer (UAS) for reconnaissance, surveillance and target acquisition for the Marine Air Ground Task Force (MAGTF) commander.<sup>21</sup> The RQ-2 has been used extensively in the Global War on Terrorism (GWOT). VMU-1, one of two Marine Corp Pioneer Squadrons, serviced over 5,501 targets, produced 2,356 imagery products, supported 103 battle damage assessments (BDA), coordinated 30 strike packages and adjusted fire over 29 times all between August 2004 and February 2005.<sup>22</sup> The Pioneer has also been used specifically for roadway reconnaissance and monitoring for Improvised Explosive Devices (IED) as well as locating potential ambush sights for U.S. convoys. The Pioneer UAS has been indispensable for the Marines in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) where it continues its service.

### **3. Shipboard Manning Implications (U.S. Navy)**

#### ***a. Shipboard System Components***

A typical RQ-2 Pioneer UAS contains approximately eight aircraft, a Ground Control Station (GCS), a Tracking Communication Unit (TCU), a Portable Control Station (PCS) as well as four remote receiving stations.<sup>23</sup> The Pioneer UAS contains a GCS (known as the GCS 2000) that has three electronics bays to include a

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<sup>19</sup> Todd Frantom, "Eyes in the Sky." [accessed 26 April 2007] available from World Wide Web @ [http://findarticles.com/p/articles/mi\\_m0IBQ/is\\_1055/ai\\_n14695839/print](http://findarticles.com/p/articles/mi_m0IBQ/is_1055/ai_n14695839/print).

<sup>20</sup> Jane's Unmanned Aerial Vehicles and Targets, [AAI/IAI RQ-2 Pioneer](#).

<sup>21</sup> RADM Anthony L. Winns, BGEN Martin Post, [Statement Before the Tactical Air and Land Forces Subcommittee](#). [accessed 20 April 2007] available from World Wide Web @ <http://www.navy.mil/navydata/testimony/aviation/winns050309.pdf>.

<sup>22</sup> Ibid.

<sup>23</sup> NAVAIR, [RQ-2 Pioneer Characteristics](#).

pilot bay, observer bay and tracking bay. (Figures 10, 11, 12) The GCS is typically manned by two personnel, the Internal Pilot (IP) and the Payload Operator (PO). (Figure 7) The GCS contains all the controls for safe operation by the IP as well as displays for image monitoring by the PO.<sup>24</sup>



Figure 7. Shipboard Ground Control Stations (GCS) [From NAVAIR]<sup>25</sup>

At sea the GCS is housed in a 20 foot Mobile Maintenance Facility (MMF) shelter that is attached to pad eyes welded to the six Pioneer configured LPDs; ashore, however, the GCS would be housed in an S-280 or S-250 shelter.<sup>26</sup> The six LPDs include the AUSTIN, CLEVELAND, DENVER, DULUTH, PONCE and SHREVEPORT.<sup>27</sup> The TCU is unmanned and contains all of the Pioneer's communications gear to include antennas as well as the data link. (Figure 8) This unit is

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<sup>24</sup> NAVAIR, RQ-2 Pioneer Characteristics.

<sup>25</sup> Ibid.

<sup>26</sup> U.S. Navy, Draft Navy Training System Plan for the Pioneer UAV. [accessed 10 May 2007] available from World Wide Web @ <http://www.globalsecurity.org/military/library/policy/navy/ntsp/UAV.htm>.

<sup>27</sup> Jane's Unmanned Aerial Vehicles and Targets, AAI/IAI RQ-2 Pioneer.

placed in an S-250 shelter aboard ship, which is separate from the MMF. The TCU is attached to the GCS by an umbilical cord that provides all communication connectivity for the Pioneer; the GCS is also connected to the ship's communication system. The PCS is a portable unit and was typically installed on the O1 level of Pioneer-configured ships.<sup>28</sup> The PCS contains an electrical power source and provides pilot controls as well as communications gear; this allows the Pioneer to be controlled independently from the GCS.<sup>29</sup> (Figure 9) The remote receiving stations (RRS) provide real-time video from the Pioneer's sensors to remote locations, typically to commanders.<sup>30</sup>

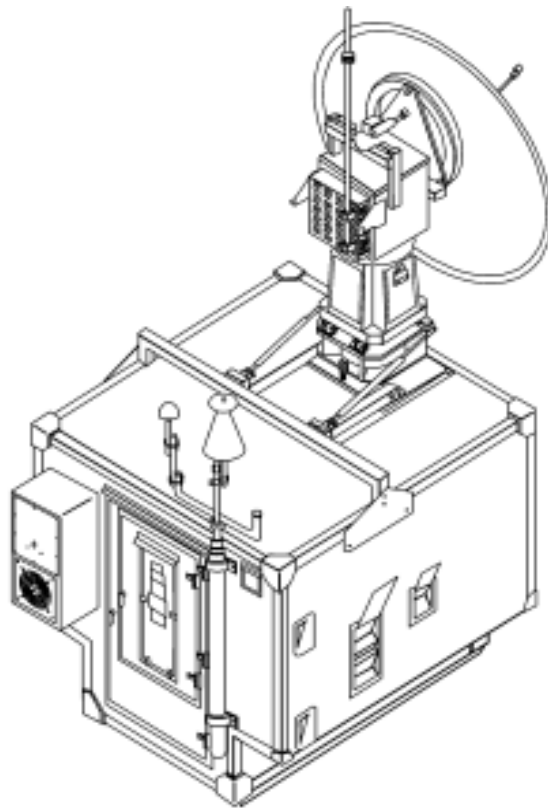


Figure 8. Tracking and Communication Unit (TCU) [From Naval Air Systems Command]<sup>31</sup>

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<sup>28</sup> U.S. Navy, Draft Navy Training System Plan for the Pioneer UAV.

<sup>29</sup> Ibid.

<sup>30</sup> NAVAIR, RQ-2 Pioneer Characteristics.

<sup>31</sup> Naval Air Systems Command, NATOPS Flight Manual Navy Model RQ-2 Pioneer UAV, 2002.

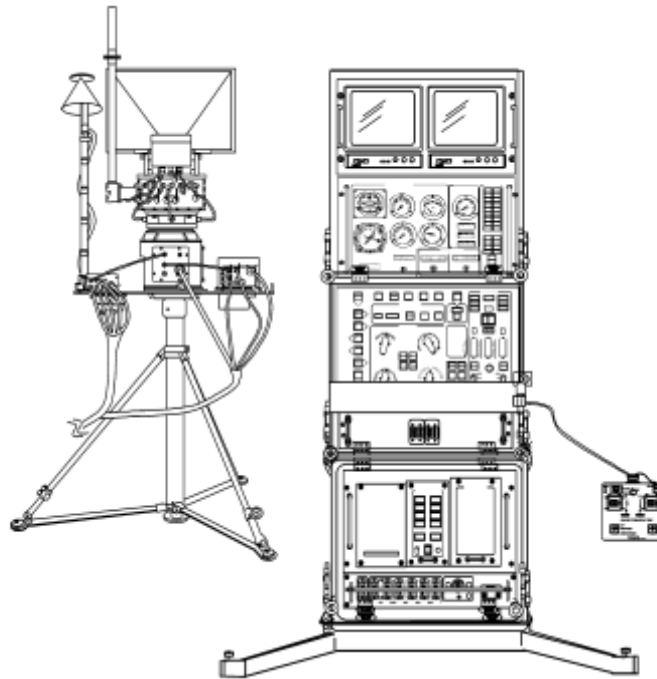


Figure 9. Portable Control Station [From Naval Air Systems Command]<sup>32</sup>

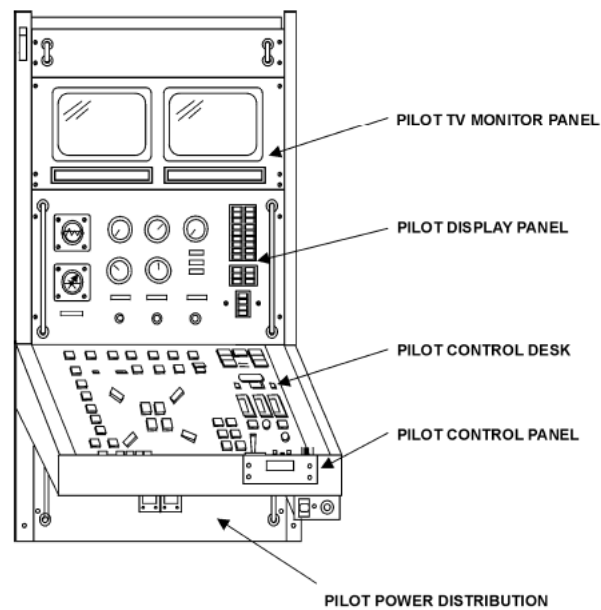


Figure 10. Pilot Control Bay [From Naval Air Systems Command]<sup>33</sup>

<sup>32</sup> Naval Air Systems Command, NATOPS Flight Manual Navy Model RQ-2 Pioneer UAV.

<sup>33</sup> Ibid.

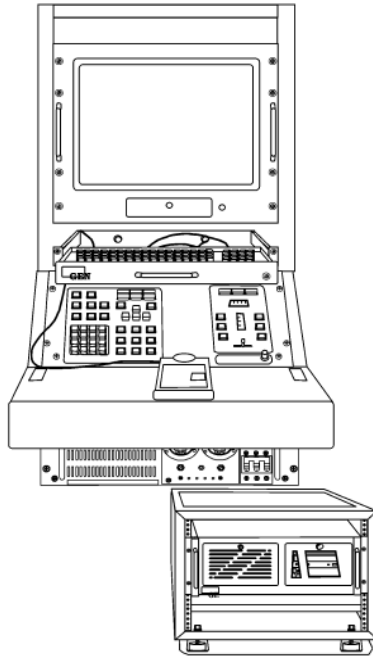


Figure 11. Tracking Bay [From Naval Air Systems Command]<sup>34</sup>

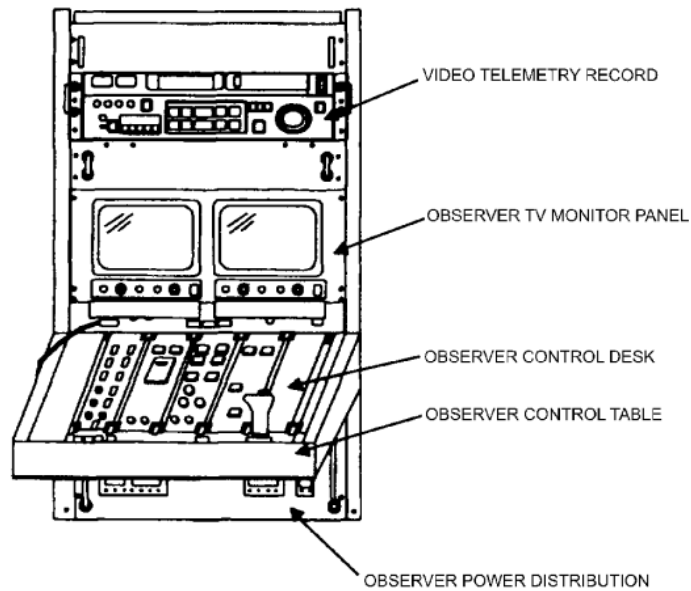


Figure 12. Observer Bay [From Naval Air Systems Command]<sup>35</sup>

<sup>34</sup> Naval Air Systems Command, NATOPS Flight Manual Navy Model RQ-2 Pioneer UAV.

<sup>35</sup> Ibid.

***b. Manpower Requirements***

According to the Pioneer Navy Training System Plan (NTSP), there are a total of eight watch-station requirements for the Pioneer UAS. They consist of the External Pilot (EP), Internal Pilot (IP), Payload Operator (PO), Mission Commander (MC), an additional EP and IP for the PCS, and two requirements for the Plane Captain and Crew Chief.<sup>36</sup> The minimum crew required to operate the RQ-2 is three, to include the MC, IP and PO; an EP is also required but typically for takeoff and landing only.<sup>37</sup> For primary operation of the Pioneer the general responsibilities for these positions are as follows:

- Mission Commander – commissioned officer responsible for all phases of operational and tactical employment of the Pioneer.
- External Pilot – usually operates the Pioneer within visual range and has control for take-off and landing.
- Internal Pilot – usually in control outside of visual range and throughout assigned missions under the guidance of the MC.
- Payload Operator – is responsible for monitoring and controlling the Pioneer's sensors.

The Pioneer UAV has all the same manning requirements regarding maintenance and ground support that regular manned aircraft have. Therefore the Pioneer has several requirements for technicians and maintenance personnel. Table 2 encompasses all pertinent rating and classifications required to stand Pioneer watch-stations as well as the maintenance support of UAV operations.

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<sup>36</sup> U.S. Navy, Draft Navy Training System Plan for the Pioneer UAV.

<sup>37</sup> Naval Air Systems Command, NATOPS Flight Manual Navy Model RQ-2 Pioneer UAV.

Table 2. RQ-2 Pioneer Manning Requirements (Navy) [After U.S. Navy]<sup>38</sup>

<b>Position</b>	<b>Designator/Rate</b>	<b>NEC</b>
(MC) Mission Commander	13XX	N/A
(EP) External Pilot	AS, AM, AE, AT, AW	8362
(PO) Payload Operator	AS, AM, AE, AT, AZ, IS	8364
(IP) Internal Pilot	AS, AM, AE, AT, AZ, AW	8363
Airframe Mechanic/Technician	AT, AE, AM, AS, AW	8361

#### **4. Ground Manning Implications (U.S. Marine Corps)**

##### ***a. Ground System Components***

The Marine Corps Pioneer UAS is the same as the Navy's at-sea version with all the same components. However according to the Marine Corps' Unmanned Aerial Vehicle Operations Manual (MCWP 3-42.1) there are five UAVs to each UAS. The GCS is not housed in an MMF like the shipboard version but is housed in an S-250 or S-280 shelter. The S-250 has the same components as the Navy's MMF and therefore houses the MC, IP and PO. However the S-280 shelter includes an intelligence bay for an intelligence analyst. (Figure 13) Again, the Marine Corps Pioneer UAS also contains

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<sup>38</sup> U.S. Navy, Draft Navy Training System Plan for the Pioneer UAV.

PCSS as well as the TCU. The Marine platoon responsible for one Pioneer UAS system will also have associated trucks, humvees and trailers for this equipment.

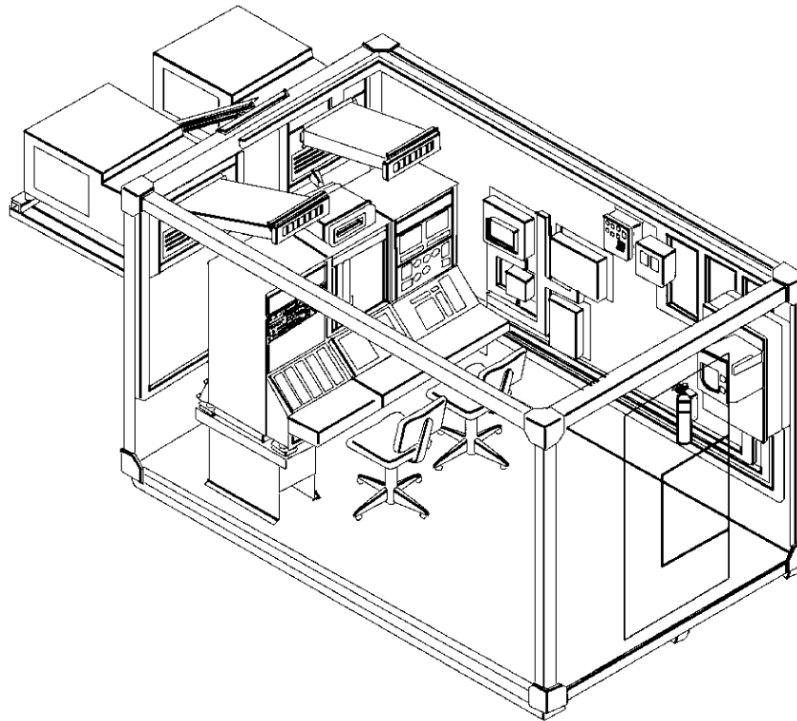


Figure 13. GCS in S-280 Shelter [From Naval Air Systems Command]<sup>39</sup>

#### ***b. Manpower Requirements***

The Marine Corps Unmanned Aerial Vehicle Squadron (VMU) is organized into several departments to include administration, intelligence, operations, logistics, communications, medical, safety and standardization as well as aviation maintenance. The Marine Corps' crew watch-stations for the Pioneer UAV are virtually the same as the Navy's but include some additional intelligence personnel. The Marine Corps also utilizes a System Operator, who is the Internal Pilot (IP) and Payload Operator (PO) combined into one position. The External Operator is the same as the Navy's External Pilot. Table 3 comprises the list of required UAV crew and maintenance personnel with the corresponding required Military Occupational Specialty (MOS).

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<sup>39</sup> Naval Air Systems Command, NATOPS Flight Manual Navy Model RQ-2 Pioneer UAV.



Table 3. RQ-2 Pioneer Manning Requirements (USMC) [After UAS Division]<sup>40</sup>

<b>Position</b>	<b>MOS</b>
Mission Commander	7315
External Operator	7316
System Operator (Internal Pilot) + (Payload Operator)	7314
Intelligence Analyst	0231
Imagery Analyst	0241
UAV Mechanic	6014
UAV Avionics Technician	6314

## C. THE RQ-7 SHADOW AND THE U.S. ARMY

### 1. General Description

The RQ-7 Shadow is a small monoplane with twin tailbooms that is constructed of composites like graphite and carbon fiber epoxy, not unlike the RQ-2. The Shadow is powered by a thirty-horsepower engine that utilizes motor gasoline (MOGAS) as its fuel source.<sup>41</sup> Also, not unlike the Pioneer, the Shadow has an electro-optic and infrared camera as its payload. The Shadow UAV is designed to be launched from a rail and recovered by an arresting gear and is also designed to be carried aboard C-130s for quick transport to operational areas. After competition and review with other potential UAV platforms the U.S. Army placed the RQ-2 Shadow into service in October of 2002. The initial units to receive delivery were the 4<sup>th</sup> Infantry Division and the 1<sup>st</sup> and 2<sup>nd</sup> Stryker Brigades.<sup>42</sup> Since that time the Shadow UAS has been distributed to many more units throughout the Army. The primary mission of the Shadow system is to provide

<sup>40</sup> UAS Division, Marine Unmanned Aircraft Systems Information, MAWTS-1 Presentation.

<sup>41</sup> Global Security, RQ-7 Shadow 200 Tactical UAV, Global Security. [accessed 16 May 2007] available from World Wide Web @ <http://www.globalsecurity.org/intell/systems/shadow.htm>.

<sup>42</sup> Jane's Unmanned Aerial Vehicles and Targets, AAI RQ-7 Shadow 200. [accessed 16 May 2007] available from World Wide Web @ <http://juav.janes.com/public/juav/index.shtml>.

situational awareness (SA), target acquisition (TA) and battle damage assessment (BDA) to the brigade level and below.<sup>43</sup> Table 4 contains Shadow's general specifications.

Table 4. RQ-7A and RQ-7B Specifications [After Office of the Secretary of Defense]<sup>44</sup>

	<b>RQ-7A</b>	<b>RQ-7B</b>		<b>RQ-7A</b>	<b>RQ-7B</b>
<b>Length</b>	11.2 ft	11.2 ft	<b>Wing Span</b>	12.8 ft	14ft
<b>Gross Weight</b>	327 lb	375 lb	<b>Payload Capacity</b>	60 lb	60 lb
<b>Fuel Capacity</b>	51 lb	73 lb	<b>Fuel Type</b>	MOGAS	MOGAS
<b>Engine Make</b>	UEL AR-741	UEL AR-741	<b>Power</b>	38 hp	38hp
<b>Data Link(s)</b>	LOS C2	LOS C2	<b>Frequency</b>	S-band UHF	S-band UHF
<b>Ceiling</b>	14,000 ft	15,000 ft	<b>Radius</b>	68 nm	68 nm



Figure 14. RQ-7 Shadow in Iraq [From Jane's]<sup>45</sup>

<sup>43</sup> Headquarters Department of the Army, Army Unmanned Aircraft System Operations, 2006.

<sup>44</sup> Office of the Secretary of Defense, Unmanned Aircraft Systems Roadmap 2005-2030.

<sup>45</sup> Jane's Unmanned Aerial Vehicles and Targets, AAI RQ-7 Shadow 200.

## **2. Overview of Missions and Operations**

To date the Shadow UAS has been used in South Korea and in the Iraqi and Afghanistan theatres of operation supporting the Global War on Terror (GWOT). As of August 2005 the AAI Corporation, which produces the Shadow UAS, stated that the RQ-7 surpassed 50,000 total flight hours of which approximately 80% were in support of combat missions in Operation Iraqi Freedom (OIF).<sup>46</sup> By October 2006 this number of flying hours surpassed 129,000 of which 85% were flown in operations within Afghanistan and Iraq.<sup>47</sup> These numbers illustrate the massive amount this platform has been utilized since its inception in 2002. The Shadow, which typically flies at an altitude of approximately one-two miles, provides troops on the ground detailed intelligence for a myriad of missions and tasks to include support of conventional combat, counter mortar operations as well as search and rescue.<sup>48</sup> These missions fall under its primary function of providing the brigade with SA, TA and BDA.

## **3. Manning Implications**

### ***a. Shadow 200 UAS System Components***

The RQ-7 Shadow 200 UAS comprises many components. A typical Shadow 200 TUAV system includes three air vehicles, one extra air vehicle for maintenance purposes, modular mission payloads, launch and recovery gear, communications equipment and GCSs.<sup>49</sup> To properly man the system, the U.S. Army utilizes a platoon of twenty-two personnel (two Officers and twenty Enlisted).<sup>50</sup> As

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<sup>46</sup> AAI Corporation, Shadow Tactical Aerial Vehicles Surpass Key 50,000-hour Flight Milestone during U.S. Army Mission in Operation Iraqi Freedom. [accessed 16 May 2007] available from World Wide Web @ [http://www.aaicorp.com/corporate/press/Shadow\\_TUAV\\_50K\\_Army\\_final.html](http://www.aaicorp.com/corporate/press/Shadow_TUAV_50K_Army_final.html).

<sup>47</sup> Jane's Unmanned Aerial Vehicles and Targets, AAI RQ-7 Shadow 200.

<sup>48</sup> Sgt. Troy Chatwin, "Spy in the Sky." [accessed 12 May 2007] available from World Wide Web @ <http://usmilitary.about.com/cs/armyweapons/a/shadowuav.htm>.

<sup>49</sup> Global Security, RQ-7 Shadow 200 Tactical UAV, Global Security.

<sup>50</sup> COL John D. Burke, Army UAV Update to Teams. [accessed 12 March 2007] available from World Wide Web @ <http://auvsipathfinder.com/>.

stated in the Army Unmanned Aircraft System Operations manual (FMI 3-04.155) the platoon, known as an aerial reconnaissance platoon, contains the following equipment:

- 4 Unmanned Aircraft (UA)
- 4 Remote Video Terminals (RVT)
- 2 Vehicle Mounted Ground Control Stations (GCS)
- 2 Ground Data Terminals (GDT)
- 2 Personnel/Equipment Transport Vehicles with Equipment Trailer
- 2 Tactical Automated Landing Systems (TALS)
- 1 Vehicle Mounted Air Vehicle Transport (AVT) with Launcher Trailer
- 1 Vehicle Mounted Mobile Maintenance Facility with Trailer
- 1 portable GCS
- 1 portable GDT<sup>51</sup>



Figure 15. RQ-7 Shadow GCS Vehicle [From Jane's]

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<sup>51</sup> Headquarters Department of the Army, Army Unmanned Aircraft System Operations.

***b. Manpower Requirements***

The U.S. Army utilizes a Vehicle Operator (VO) and a Mission Payload Operator (MPO); the VO is equivalent to the Navy and Marine Corps' IP and the MPO is equivalent to the PO. For the Shadow UAS the Army does not utilize an EP. The 96U MOS encompasses both the VO and MPO positions. The generic description for the position is UAS Operator, who is responsible for performance planning, remote operating of the UAV, operating payload sensors and UAV recovery.<sup>52</sup>

The 33W and 52D maintenance personnel are not only responsible for maintenance and repairs but also preparation for launch and recovery operations. To properly man the Shadow UAS system the U.S. Army utilizes the following types of personnel.

Table 5. RQ-7 Shadow UAS Platoon Manning Requirements [After Sundberg]<sup>53</sup>

<b>Position</b>	<b>MOS</b>	<b>Quantity</b>
Platoon Leader	35D	1
UAV Warrant Officer	350U	1
Platoon Sergeant	96U	1
Air Vehicle Operators	96U	12
EW System Repairer	33W	4
Engine Mechanic	52D	3

**D. SUMMARY**

The RQ-2 Pioneer and RQ-7 Shadow UAV systems have virtually the same components and missions that determine the composition of their respective watch teams. As a result the manpower requirements among the different services are very similar. The Army has combined the Payload Operator (PO) job specialty, the Internal Pilot (IP) job specialty and the External Pilot (EP) job specialty into one Military Occupation

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<sup>52</sup> Headquarters Department of the Army, Army Unmanned Aircraft System Operations.

<sup>53</sup> John C. Sundberg, Army Unmanned Aerial Vehicle Systems, NDIA Symposium. [accessed 12 March 2007] available from World Wide Web @ <http://www.dtic.mil/ndia/2002targets/sundberg.pdf>.

Specialty (MOS) of 96U. The 96U MOS fills the Vehicle Operator (VO) watch station and the Mission Payload Operator (MPO) watch station; the VO assumes both the IP and EP job responsibilities. The Marines combined the IP and PO positions into one MOS, 7314, creating the single position of System Operator to encompass both jobs. The EP is still a separate watch station. The Marine Corps also utilizes intelligence and imagery analysts for its Pioneer UAS. The Navy utilizes three different NECs for the EP, PO and IP (8362, 8364 and 8363, respectively). All three of these watch stations are separate compared to the Army and Marine Corps versions. All systems have requirements for both mechanic and electronics technicians for maintenance purposes. This overview establishes a foundation for looking at the operational manpower requirements for the Fire Scout VTUAV to include a thorough study of the NECs as well as the occupational standards required for this new system.

### **III. OPERATIONAL EMPLOYMENT AND MANNING CONSIDERATIONS OF THE RQ-8 FIRE SCOUT AND THE LITTORAL COMBAT SHIP**

#### **A. THE LITTORAL COMBAT SHIP**

##### **1. General Description**

The Littoral Combat Ship (LCS) is a new class of combatant that is mission focused, fast, relatively small, versatile and designed to operate in the littorals. Currently there are two versions, a semi-planing monohull type built by Lockheed Martin and an aluminum trimaran version built by General Dynamics. LCS 2, the U.S.S. INDEPENDENCE, is the trimaran version under construction in Mobile, Alabama; it was laid down on 19 January 2006 and is illustrated in Figure 16. LCS 1, the U.S.S. FREEDOM, is the monohull version and is currently under construction in Marinette, Wisconsin; it was launched on 23 September 2006. (Figure 17) Both of these ships are Flight 0 versions that the Navy plans on producing through FY 2009; however, there are intentions to design and implement a Flight 1 style in the near future.<sup>54</sup> The Navy anticipates procuring approximately fifty-six of these ships and will eventually decide on one of the two seaframe designs after a thorough assessment of each.<sup>55</sup>

The LCS concept exploits a modular design that enables the ship to “plug in” three different mission capabilities referred to as Focused Mission Packages (FMPs). These changeable packages are what give LCS its versatility and unique functionality. The former Secretary of the Navy, Gordon England, describes the LCS best by stating, “The goal is to develop a platform that can be fielded in relatively large numbers to support a wide range of joint missions, with reconfigurable mission modules to assure

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<sup>54</sup> Ronald O’Rourke, Navy Littoral Combat Ship (LCS) Program: Oversight Issues and Options for Congress CRS Report. [accessed 10 May 2007] available from World Wide Web @ <http://www.fas.org/sgp/crs/weapons/RL33741.pdf>.

<sup>55</sup> Department of Defense, Navy Terminates Littoral Combat Ship 3. [accessed 12 June 2007] available from World Wide Web @ <http://www.insidedefense.com>.



access to the littorals in the face of threats from surface craft, submarines, and mines.”<sup>56</sup> This concept of developing a platform to operate in the littorals stemmed from Admiral Arthur Cebrowski, former president of the Naval War College, who believed that the U.S. Navy’s large aircraft carriers and battlegroups were not effective in dealing with near-shore problem areas.<sup>57</sup> This new concept eventually led to the design and production of this small but highly innovative and versatile platform

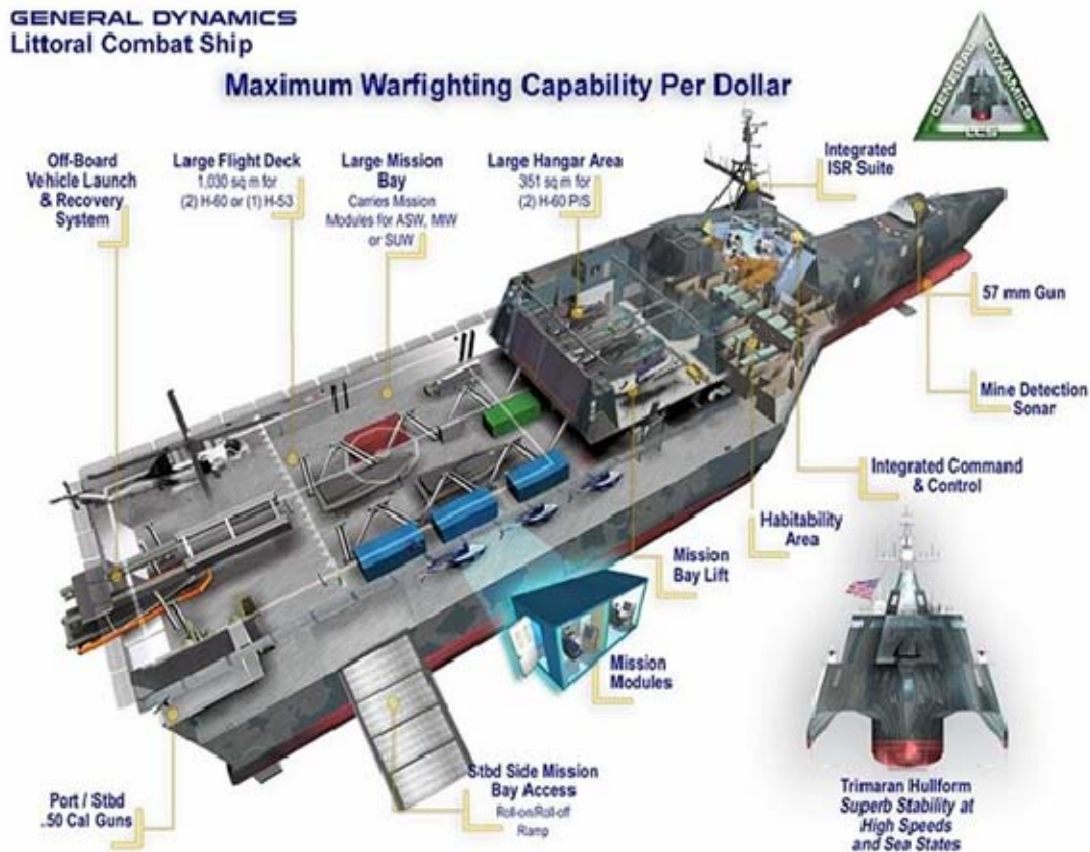


Figure 16. General Dynamics Independence Class LCS [From Global Security]<sup>58</sup>

<sup>56</sup> Global Security, Littoral Combat Ship. [accessed 20 June 2007] available from World Wide Web @ <http://www.globalsecurity.org/military/systems/ship/lcs.htm>.

<sup>57</sup> Christopher Griffin and Dan Blumenthal, “LCS: A Solution for the Asia Littoral.” [accessed 14 June 2007] available from World Wide Web @ <http://www.armedforcesjournal.com/2006/12/2132003>.

<sup>58</sup> Global Security, Littoral Combat Ship.





Figure 17. Lockheed Martin Freedom Class LCS [From Global Security]<sup>59</sup>

## 2. LCS General Characteristics

Both LCS platforms have to meet the specific design requirements as specified in the Preliminary Design Interim Requirements Document.<sup>60</sup> The specifications in this document delineate that the LCS must have specific mission packages, a limited number of personnel, the capability of operating surface craft as well as aircraft, a lengthy service life, limited displacement and exceptional range to name a few.<sup>61</sup> Both General Dynamics and Lockheed Martin have met these requirements, each with slight variations in characteristics as shown in Table 6.

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<sup>59</sup> Global Security, Littoral Combat Ship.

<sup>60</sup> Program Executive Office Ships, LCS Flight 0 Preliminary Design Interim Requirements Document. [accessed 10 June 2007] available from World Wide Web @ [http://peoships.crane.navy.mil/lcs/industryday/LCS\\_IRD\\_10February2003.pdf](http://peoships.crane.navy.mil/lcs/industryday/LCS_IRD_10February2003.pdf).

<sup>61</sup> Ibid.

Table 6. General Characteristics of the LCS [From Program Executive Office Ships]<sup>62</sup>

Variants	Lockheed Martin	General Dynamics
<b>Displacement:</b>	3,089 tons, full load	2,790 tons, full load
<b>Dimensions, feet (metres):</b>	379.0 × 43.0 × 12.8 (115.5 × 13.1 × 3.9)	417.3 × 99.7 × 14.8 (127.2 × 30.4 × 4.5)
<b>Main machinery:</b>	CODAG: 2 Rolls Royce MT-30 gas turbines; 96,550 hp (72 MW); 2 Fairbanks Morse Colt-Pielstick 16PA6B diesels; 17,160 hp (12.8 MW); 4 Rolls Royce Kamewa 153SII waterjets	CODAG: 2 gas turbines, 2 diesels; 4 steerable waterjets; 1 steerable thruster
<b>Speed, knots:</b>	45	45
<b>Range, n miles:</b>	3,500 at 18 kt	4,300 at 18 kt
<b>Complement: :</b>	50	40
<b>Missiles:</b>	Raytheon RAM	Raytheon RAM
<b>Guns:</b>	1 United Defence 57 mm/70 Mk 2; 220 rds/min to 17 km (9 n miles); weight of shell 2.4 kg. 4-12.7 mm MGs	1 United Defence 57 mm/70 Mk 2; 220 rds/min to 17 km (9 n miles); weight of shell 2.4 kg. 4-12.7mm MGs
<b>Countermeasures:</b>	2 SKWS/SRBOC decoy launching systems. WBR 2000 ESM	Decoys: ESM/ECM EDO ES 3601 ESM
<b>Combat data systems:</b>	COMBATSS-21	Northrop Grumman Electronic Systems Integrated Combat Management System (ICMS)
<b>Weapons control:</b>	To be announced	TACTICOS
<b>Radars: Air/surface search:</b>	EADS TRS-3D; C-band	Ericson Sea Giraffe; G/H-band
<b>Navigation:</b>	NAVSSI/GPS/WSN7V	Sperry Bridgmaster
<b>Fire control:</b>	DORNA EOD EO/IR System	SEASTAR SAFIRE III EO/IR
<b>Sonars:</b>	None	None
<b>Helicopters:</b>	2 MH-60 R/S helicopters or 1 MH-60 R/S and 3 Firescout VTUAVs	2 H-60 helicopters; multiple UAVs/VTUAVs; large flight deck area can accommodate CH-53

<sup>62</sup> Program Executive Office Ships, LCS Fact Sheet. [accessed 2 July 2007] available from World Wide Web @ <http://peoships.crane.navy.mil/lcs/factsheet.htm>.

### 3. Overview of Missions and Operations

The three LCS primary missions are mine warfare (MIW), anti-submarine warfare (ASW) as well as surface warfare operations (SUW), designed to operate in near-shore areas known as the littorals. The three are shown in Figures 18, 19 and 20. The secondary LCS missions include special operations forces (SOF) support; intelligence, surveillance and reconnaissance (ISR); maritime interception operations (MIO); and logistics support.<sup>63</sup> The LCS is not intended to be a multi-mission platform but a mission-specific one depending on the installed package. Each LCS will have a core “seaframe” that is composed of a core crew that will be augmented by specific FMPs and associated crew.

Each primary mission package contains the specific software, hardware and personnel to conduct a variety of specific tasking.<sup>64</sup> The Navy plans on acquiring 119 FMPs for the fifty-six estimated sea frames.<sup>65</sup> These FMPs will be executed by being inserted or “plugged into” the core sea frame.



Figure 18. LCS MIW Mission Package Components [From Czapiewski]<sup>66</sup>

<sup>63</sup> O’Rourke, Navy Littoral Combat Ship (LCS) Program: Oversight Issues and Options for Congress CRS Report.

<sup>64</sup> Thaveephone Douangaphaivong, Littoral Combat Ship (LCS) Manpower Requirements Analysis. Master’s Thesis, Naval Postgraduate School, December 2004.

<sup>65</sup> Ibid.

<sup>66</sup> Pete Czapiewski, Littoral Combat Ship ONR Man Tech/NSRP Ship Tech. 2005.



Figure 19. LCS ASW Mission Package Components [From Czapiewski]<sup>67</sup>



Figure 20. LCS SUW Mission Package Components [From Czapiewski]<sup>68</sup>

<sup>67</sup> Pete Czapiewski, *Littoral Combat Ship ONR Man Tech/NSRP Ship Tech*. 2005.

<sup>68</sup> Ibid.

#### **4. Manning Considerations**

To keep operating costs as low as possible the LCS is following a minimally manned concept. Keeping the number of required sailors as low as possible to maintain operational effectiveness is a major objective for the U.S. Navy. Technology and automation are critical components in reducing workload and thereby accommodating lower manning levels. The LCS has a targeted level of forty manpower requirements for the core crew which does not include the requirements for the embarked FMPs.<sup>69</sup> The core seaframe plus any one focused mission module package is targeted to have seventy-five manpower requirements.<sup>70</sup> In his Naval Postgraduate School thesis regarding LCS manning requirements, Thaveephone Douangaphaivong states that even with new “paradigm shifts” in improved manning requirements determination the number of personnel would still be high. He states that there would be forty-five requirements for the seaframe (core crew), plus fifty-five more for the MIW mission module, fifty more for the ASW mission module and forty-five additional requirements for the SUW mission module.<sup>71</sup> This equates to ninety to 100 manpower requirements for all three primary mission modules, which exceed the original stated requirement by fifteen to twenty-five requirements.<sup>72</sup> Therefore any ideas that maximize watch standing capability or that reduce manpower requirements for any system—like the Fire Scout—aboard the LCS must be considered.

#### **B. RQ-8 FIRE SCOUT**

##### **1. General Description**

The RQ-8 Fire Scout is a vertical take-off and landing unmanned aerial vehicle (VTUAV) produced by the Northrop Grumman Corporation. It is designed to replace the RQ-2 Pioneer for the U.S. Navy and will be implemented aboard the new Littoral

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<sup>69</sup> O’Rourke.

<sup>70</sup> Douangaphaivong.

<sup>71</sup> Ibid.

<sup>72</sup> Ibid.

Combat ship. The Fire Scout is an unmanned version of the Schweizer 333 light helicopter, which is built by the Schweizer Aircraft Corporation. Northrop Grumman modified the Schweizer 333 for unmanned flight and in February of 2000 received \$93.7 million from the U.S. Navy for a manufacturing contract.<sup>73</sup> There are two versions of this aircraft, the RQ-8A and the MQ-8B, which have some significant differences between them. The RQ-8A version has a three-blade main rotor, as illustrated in Figure 21, whereas the MQ-8B has a four-blade main rotor; both types of rotors fold for storage. The MQ-8B version of the Fire Scout has different sensors and avionics, greater fuel capacity, greater payload capacity as well as side-mounted sponsons for weapons as illustrated in Figures 22 and 23.<sup>74</sup> The RQ-8A is designed to carry a 200 lb payload that is typically comprised of intelligence, surveillance and reconnaissance gear; the MQ-8B has a 600 lb payload that will include additional payloads such as rocket launchers and other weapons.<sup>75</sup> The RQ-8B version was re-designated the MQ-8B in the middle of 2005 to reflect its multiple mission capability and payload. As of 24 May 2007, the U.S. Navy has nine MQ-8B Fire Scout VTUAVs in service or on order and anticipates reaching upward to 200 air vehicles in the near future.<sup>76</sup>

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<sup>73</sup> Richard R. Burgess, "Fire Scout UAV is Poised as Sensor, Shooter for Littoral Combat Ship." [accessed 2 July 2007] available from World Wide Web @[http://www.navyleague.org/sea\\_power/may\\_04\\_25.php/](http://www.navyleague.org/sea_power/may_04_25.php/).

<sup>74</sup> Jane's Unmanned Aerial Vehicles and Targets, Northrop Grumman, MQ-8 Fire Scout. [accessed 12 June 2007] available from World Wide Web @<http://juav.janes.com/public/juav/index.shtml>.

<sup>75</sup> Geoff Fein, "After Autonomous Flight Demonstration Fire Scout Set For Tests on Navy HSV." 10 February 2006.

<sup>76</sup> Defense Industry Daily, The Fire Scout VTUAV Program: By Land and By Sea. [accessed 14 June 2007] available from World Wide Web @<http://www.defenseindustrydaily.com/the-fire-scout-vtuav-program-by-land-and-by-sea-uploaded-01316/>.



Figure 21. RQ-8A Fire Scout Cutaway [From Jane's]<sup>77</sup>



Figure 22. MQ-8B Fire Scout [From Jane's]<sup>78</sup>

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<sup>77</sup> Jane's Unmanned Aerial Vehicles and Targets, Northrop Grumman, MQ-8 Fire Scout.

<sup>78</sup> Ibid.





Figure 23. MQ-8B Fire Scout [From Jane's]<sup>79</sup>

## 2. Overview of Missions and Operations

The Fire Scout has a modular design not unlike the LCS that enables it to adapt to various operational requirements through the “plugging in” of various payloads. The Concept of Operations for the Fire Scout VTUAV is still in development but is expected to be deployed in conjunction with the new SH-60R helicopter aboard the LCS. Currently the Fire Scout UAS is an integral component of the three primary mission modules. Some of the missions Fire Scout supports are real-time ISR imagery, communications relay, battle damage assessment information as well as obtaining precision targeting data.<sup>80</sup> As previously mentioned, research is ongoing to weaponize the Fire Scout to increase its versatility by giving it a target neutralization capability. The Defense Industry Daily Website states, “At present, the Fire Scout is expected to arm

<sup>79</sup> Jane's Unmanned Aerial Vehicles and Targets, Northrop Grumman, MQ-8 Fire Scout.

<sup>80</sup> Space War Your World At War, U.S. Navy Buys Two Northrop Grumman Fire Scouts. [accessed 12 June 2007] available from World Wide Web @ <http://www.spacewar.com>.



itself with gun pods, Hydra 70mm rocket pods, and Hellfire II laser-guided missiles.”<sup>81</sup> The Fire Scout will provide increased capability and effectiveness for each of the LCS primary mission modules.

### **3. Fire Scout Components and General Characteristics**

#### ***a. Fire Scout UAS Component Overview***

The Fire Scout VTUAV system contains several components that are extremely similar to the RQ-2 Pioneer and RQ-7 Shadow systems. Although the Fire Scout UAS is in its infancy and developmental stages it will still be operated from a GCS. However, the GCS aboard the LCS is to be integrated into the ship’s Combat Information Center (CIC) but it can also be housed in an S-280 shelter for use aboard other ship platforms.<sup>82</sup> The Fire Scout GCS will have the same function as the Pioneer’s with full control as well as displays for payload imagery. One significant difference for the Fire Scout GCS is that it can simultaneously operate all three air vehicles.<sup>83</sup> Other components in the system include modular mission payloads (MMP) not unlike the LCS, remote data terminals (RDT) as well as communications and launch and recovery gear—again very similar to the Pioneer and Shadow UAV systems. As specified in the VTUAV Operational Requirements Document the following number of components will comprise one system: two GCSs, four EO/IR laser designator MMPs, two RTDs and four air vehicles.<sup>84</sup> The LCS, however, will only have three air vehicles comprising its VTUAV system.

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<sup>81</sup> Defense Industry Daily, The Fire Scout VTUAV Program: By Land and By Sea.

<sup>82</sup> Northrop Grumman, RQ-8B Fire Scout Vertical Takeoff Unmanned Air Vehicle. 2003.

<sup>83</sup> Jane’s Unmanned Aerial Vehicles and Targets, Northrop Grumman, MQ-8 Fire Scout.

<sup>84</sup> Global Security, RQ-8A Fire Scout Vertical Take Off and Landing Tactical Unmanned Aerial Vehicle (VTUAV). [accessed 23 July 2007] available from World Wide Web @ <http://www.globalsecurity.org/intell/systems/vtuav.htm>.

*b. MQ-8B Fire Scout Specifications*

Table 7. Specifications of the MQ-8B Fire Scout [After Northrup Grumman]<sup>85</sup>

<b>Length Folded</b>	<b>22.87 ft</b>
<b>Rotor Diameter</b>	<b>27.50 ft</b>
<b>Height</b>	<b>9.42 ft</b>
<b>Gross Weight</b>	<b>3,150 lbs</b>
<b>Engine</b>	<b>Rolls-Royce, Model 250-C20W</b>
<b>Speed</b>	<b>125 + knots</b>
<b>Ceiling</b>	<b>20,000 ft</b>
<b>Total Flight Time with Baseline Payload</b>	<b>8 + hours</b>
<b>Total Flight Time with 500 lb Payload</b>	<b>5 + hours</b>
<b>Payloads</b>	<b>EO / IR / LC BRITE Star II</b> <b>UHF / VHF Comm Relay</b> <b>COBRA Mine Detector</b> <b>Airborne Comm Package</b>

*c. Endurance of the Fire Scout*

The Navy's VTUAV system, according to the VTUAV NTSP, will be capable of remaining on station for twelve continuous hours with one VTUAV system per battlegroup or twenty-four continuous hours with two systems. Two Fire Scout systems will provide twenty-four hours of continuous coverage out to 110 nautical miles.<sup>86</sup> Also at 110 nautical miles the Fire Scout will be able to provide more than five

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<sup>85</sup> Northrop Grumman, MQ-8B Fire Scout Facts. [accessed 12 July 2007] available from World Wide Web @[http://www.is.northropgrumman.com/systems/system\\_pdfs/Factsheet\\_FireScout.pdf](http://www.is.northropgrumman.com/systems/system_pdfs/Factsheet_FireScout.pdf).

<sup>86</sup> The UAV Website, MQ-8B. [accessed 12 July 2007] available from World Wide Web @[http://www.theuav.com/fire\\_scout\\_uav](http://www.theuav.com/fire_scout_uav).

hours time on station with a standard payload.<sup>87</sup> The baseline MQ-8B, containing the basic ISR payload, has a maximum endurance of over eight hours and with an additional 600 lb payload it will have an endurance of approximately five hours.<sup>88</sup> This persistent on-station time will play a vital role in determining manpower requirements.

*d. Automatic Landing Capability*

A major Fire Scout system advantage is its ability to land and take-off automatically without operator intervention. The Fire Scout VTUAV has the unique ability to land on any air-capable ship as well as unprepared ground combat areas.<sup>89</sup> The ability to autonomously land is a result of the UAV Common Automatic Recovery System (UCARS).<sup>90</sup> On 16 and 17 January 2006 the U.S.S. NASHVILLE (LPD 13), utilizing UCARS, successfully and autonomously landed the Fire Scout VTUAV nine times and within inches of its landing spot. The Deputy Director of Tactical UAV Programs at Northrop Grumman and the Fire Scout Program Manager, Douglas Fronius, stated, “With UCARS, you can land in any weather condition, within inches.”<sup>91</sup>

*e. Control of the Fire Scout*

The Fire Scout UAS has the unique capability of being controlled by almost any platform with the proper technology. The technology that provides this control capability is the Tactical Control System (TCS). The TCS is the software and hardware that provides the five levels of control and they are illustrated in Table 8. The TCS has six subsystems, which include a line-of-sight antenna assembly, integrated data terminal, datalink control module, computer, synthetic aperture radar subsystem as well

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<sup>87</sup> The UAV Website, MQ-8B.

<sup>88</sup> Jane’s Unmanned Aerial Vehicles and Targets, Northrop Grumman, MQ-8 Fire Scout.

<sup>89</sup> Naval Technology, Fire Scout – VTUAV Unmanned Aerial Vehicle. [accessed 6 July 2007] available from World Wide Web @[http://www.naval-technology.com/project\\_printable.asp?ProjectID=1494](http://www.naval-technology.com/project_printable.asp?ProjectID=1494).

<sup>90</sup> Fein.

<sup>91</sup> Ibid.

as a workstation.<sup>92</sup> Any platform with TCS will have the ability to control the Fire Scout. This capability was demonstrated when a Navy P-3C Orion using TCS technology controlled and landed a Fire Scout VTUAV in December of 2003.<sup>93</sup> This technology is also extremely compatible throughout the armed services as stated by Jane's, "TCS demonstrated a capability to interface directly with every major C4I system currently in use by the U.S. Military."<sup>94</sup> This versatility could be advantageous by having multiple units, ground as well as sea based, share control of the same Fire Scout system.

Table 8. Level of Control [After U.S. Navy]<sup>95</sup>

<b>Level</b>	<b>LEVEL OF CONTROL</b>
<b>1</b>	<b>Receipt and transmission of secondary imagery and/or data.</b>
<b>2</b>	<b>Direct receipt of imagery and/or data.</b>
<b>3</b>	<b>Control of the MMP plus Level 2.</b>
<b>4</b>	<b>Control of the UAV, less launch and recovery, plus Level 3.</b>
<b>5</b>	<b>Full function and control of the UAV from takeoff to landing.</b>

#### 4. Manpower Requirements

The Fire Scout is to be deployed aboard the Littoral Combat Ship and operated by the embarked air detachment.<sup>96</sup> The Air Detachment is a vital component to all three primary mission modules and consists of one SH-60R LAMPS and one VTUAV system that consists of three Fire Scouts. The quantitative and qualitative manpower

<sup>92</sup> Jane's, Integrated Tactical Management/Control System (TMS/TCS). [accessed 10 July 2007] available from World Wide Web @ <http://www8.janes.com>.

<sup>93</sup> NAVAIR, NAVAIR Demonstrates UAV Control At Highest Level. [accessed 12 July 2007] available from World Wide Web @ [http://uav.navair.navy.mil/new\\_firescout/news/rotorhub\(UK\).pdf](http://uav.navair.navy.mil/new_firescout/news/rotorhub(UK).pdf).

<sup>94</sup> Jane's, Integrated Tactical Management/Control System (TMS/TCS).

<sup>95</sup> U.S. Navy, VTUAV COE Draft G. [accessed 26 April 2007] available from World Wide Web @ <http://www.fas.org/irp/program/collect/docs/VTUAVREVGCOE.htm>.

<sup>96</sup> NAVAIR, Born Survivor – An In-Depth Look at the Northrop Grumman MQ-8B Fire Scout. [accessed 26 April 2007] available from World Wide Web @ [http://uav.navair.navy.mil/new\\_firescout/news/BornsurvivorMQ8B\\_dec1306.htm](http://uav.navair.navy.mil/new_firescout/news/BornsurvivorMQ8B_dec1306.htm).

requirements of the Air Detachment aboard LCS is still under evaluation. However, the Navy Training System Plan for the Naval VTUAV states that the manning for operating the Fire Scout will consist of two watchstations: the Mission Payload Operator (MPO) and the Air Vehicle Operator (AVO).<sup>97</sup> One of these positions will also act as the Mission Commander (MC). Therefore the MPO and AVO positions will be filled by either the Mission Commander or a UAV Operator. According to the VTUAV NTSP the operators are projected to consist of three officers and three enlisted personnel. Table 9 (page 43) describes the required positions, associated rates, qualifications and training for the Navy to operate the Fire Scout.

### **C. SUMMARY**

The Fire Scout's unique capability and versatility allow new and innovative approaches to operational control and manning concepts. The VTUAV NTSP states that a detachment should have three officers and three enlisted personnel to operate the air vehicle, a total of six manpower requirements. The manpower requirements could theoretically be reduced, or at a minimum the watch rotation may be extended by capitalizing on the endurance, control flexibility and automation of this platform. Ensuring that units within a particular Area of Responsibility (AOR) are properly equipped with the necessary TCS software as well as trained personnel could open a vast amount of operational flexibility and capability. It may have the potential of lowering manpower requirements as well as easing operational workload. This would allow the Fire Scout aboard LCS, or any other air-capable platform, to be a true joint asset with the appropriate technology and training.

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<sup>97</sup> U.S. Navy, Navy Training System Plan for the Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle. [accessed 26 April 2007] available from World Wide Web @ [http://www.globalsecurity.org/military/library/policy/navy/ntsp/vtuav-d\\_2001.pdf](http://www.globalsecurity.org/military/library/policy/navy/ntsp/vtuav-d_2001.pdf).

The capability of the Fire Scout can only be capitalized upon if the technology and manpower is provided to units throughout the services. The technology portion is made relatively easy with the TCS software and hardware, which is highly compatible with many systems throughout the military. However, the manning of such a system may be more complicated. According to the NTSP, the only qualified ratings to operate a VTUAV are air ratings. If the Fire Scout flies to a particular air-capable ship that does not have a qualified air detachment embarked, why can't a surface rating be qualified to operate such a system? The paradigm of having only aviation ratings operate the Fire Scout should be challenged due to existing technology. To facilitate such an argument an in-depth analysis of the Knowledge Skills and Abilities as well as occupational standards of aviation and surface ratings should be examined.

Table 9. Fire Scout VTUAV Manpower Requirements [After U.S. Navy]<sup>98</sup>

<p><b>Mission Commander, Designator 13XX</b></p> <ul style="list-style-type: none"> <li>• Air Warfare Qualified Officer</li> <li>• Formal Training</li> </ul> <p><b>UAV Air Vehicle Operator, NEC 83XA</b></p> <ul style="list-style-type: none"> <li>• Primary NEC</li> <li>• Formal Training</li> <li>• E-5 through E-7</li> <li>• Source Ratings – Any enlisted aviation rating E-5 or above</li> <li>• Naval Air Training and Operating Procedures Standardization (NATOPS) Qualified</li> <li>• Air Intercept Controller</li> </ul> <p><b>UAV System Technician, NEC 83XB</b></p> <ul style="list-style-type: none"> <li>• Primary NEC</li> <li>• Formal Training</li> <li>• E-2 through E-8</li> <li>• Source Ratings – AD, AE, AM, AT</li> </ul> <p><b>UAV Systems Administrator, NEC 83XC</b></p> <ul style="list-style-type: none"> <li>• Secondary NEC</li> <li>• Formal Training</li> <li>• E-5 through E-8</li> <li>• Source Ratings – AT (ET and FC decision pending)</li> </ul> <p>(This will be a secondary NEC for the UAV Systems Technician)</p>
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<sup>98</sup> U.S. Navy, Navy Training System Plan.

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## **IV. VTUAV OPERATORS AND MANNING IMPLICATIONS**

### **A. FACTORS AFFECTING UAV OPERATOR ELIGIBILITY**

#### **1. Aircraft Pilot and UAV Operator Paradigm**

There is a growing debate as to who constitutes the optimum operator for unmanned systems. Both the military and civilian sectors are simultaneously dealing with this dilemma caused by technological advances in the automation, large variety, culture and relative infancy of UAV platforms. Many feel that qualified pilots of manned aircraft are the best answer to this question. Others feel that the increased automation in flying capability and the cost effectiveness of “non-pilots” are enough to challenge the validity of this paradigm. Currently military aviation and civilian aviation leaders are trying to develop a comprehensive list of standards to gauge who best qualifies to fly UAVs.

#### **2. U.S. Military UAV Operator Selection Considerations**

Determining the best qualified personnel for operating UAVs is a complex and cultural process with many variables. Currently, the U.S. Air Force is the only branch of service that stipulates that qualified pilots will operate UAVs. The Army, Navy and Marine Corps operate their UAVs with personnel other than “pilots.” There are numerous variables that account for this divergence in determining who best qualifies to operate an Unmanned Aerial Vehicle. The variables under consideration for who is best qualified to fly UAVs range from organizational culture to budgetary matters.

##### ***a. Culture***

The U.S. Air Force is a “pilot centric” organization that holds the highest regard for its aviators; the other services do as well but are not completely dominated by this cultural phenomenon. As a result, the Air Force has been reluctant to allow air vehicles to be operated by non-pilots; this is similar to the problem they faced when

instituting cruise missiles.<sup>99</sup> This cultural aspect is highlighted by Major James C. Hoffman, USAF, and Charles Tustin Kamps who state in their UAV manning article, “The Air Force’s senior and midlevel leadership, controlled by the pilot community, could become a cultural impediment to the UAV ‘revolution’, just as it hindered the proliferation of cruise missiles in the latter part of the Cold War.”<sup>100</sup> Anything that threatens a pilot’s status in the Air Force is met with resistance, even if the perceived threat means improved efficiency and effectiveness. The Navy predominately believes UAV operators should be enlisted aviation rates, which constitutes a different cultural impediment not unlike that of the Air Force. This may prevent or slow the progress for an optimum manning solution.

#### ***b. UAV Control Aspects***

The level of automation regarding Unmanned Aerial Vehicles is a critical factor in determining the best qualified operator for the military. There is a fear of removing the certified pilot requirement from UAV platforms that have control features similar to conventional manned aircraft. UAVs can be classified into two categories: remotely piloted vehicles or autonomous vehicles. Remotely piloted UAVs are those that require a pilot to launch and recover the air vehicle, and which also have stick and rudder controls like conventional manned aircraft. These UAVs have little automation regarding flight control. Autonomous vehicles are controlled by software where the operator selects waypoints and the aircraft essentially flies itself.<sup>101</sup> Autonomous vehicles also typically take-off and land via computer and software. The Air Force Predator UAV has stick, rudder and throttle controls just like a conventional aircraft and is flown by

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<sup>99</sup> Major James C. Hoffman and Charles Tustin Kamps. “At the Crossroads, Future ‘Manning’ for Unmanned Aerial Vehicles”, [accessed 17 July 2007] available from World Wide Web @<http://www.airpower.maxwell.af.mil/airchronicles/apj/apj05/spr05/hoffman.html>.

<sup>100</sup> Ibid.

<sup>101</sup> Paul Sossong. “Crew Resource Management in Unmanned Aircraft”, [accessed 17 July 2007] available from World Wide Web @[http://www.safetycenter.navy.mil/Aviation/articles/CRM\\_UAV.htm](http://www.safetycenter.navy.mil/Aviation/articles/CRM_UAV.htm).

qualified pilots.<sup>102</sup> The MQ-8B Fire Scout will fall into the latter category, having autonomous controls. This control dynamic of the Fire Scout will make it easier for Sailors to operate.

*c. Manning Availability and Cost*

The level of personnel inventory and the cost of training UAV Operators are both critical aspects to the distribution process. The U.S. Air Force is currently in a shortage of UAV operators and is taking pilots involuntarily from their conventional aircraft to fly these platforms.<sup>103</sup> According to the article by Major Hoffman and Charles Kamps, the Air Force is encountering short falls in pilot manning levels as a result of high operational tempo. Also stated in the article is the fact that the Air Force is having difficulty in finding even twenty pilots a year to volunteer for the approximately 170 UAV operator billets required annually.<sup>104</sup> Therefore, “thinking outside the box” to find other available manning resources is required.

An alternative UAV manning plan that was suggested to the U.S. Air Force was recently found to be cost effective. The Hoffman and Kamps article proposed training non-pilot Air Force officers who are motivated to enter the UAV community. According to their study this would alleviate the manning problem as well as provide significant cost savings in training. Tables 10 and 11 illustrate this cost savings by comparing the training of non-pilots to that of B-52 pilots who will be removed from their career pipeline temporarily to fly UAVs. Table 10 calculates the cost of training a B-52 pilot as the cost of basic flight training, known as Specialized Undergraduate Pilot Training (SUPT), plus the Initial Qualification Training (IQT) for the B-52 as the total cost. Table 11 figures the cost for training a non-pilot as the cost of Initial Flight

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<sup>102</sup> Frank Colucci. “Air Force Refines Training Programs for UAV Operators”, [accessed 3 August 2007] available from World Wide Web @ [http://www.nationaldefensemagazine.org/issues/2004/May/Air\\_Force\\_Refines.htm](http://www.nationaldefensemagazine.org/issues/2004/May/Air_Force_Refines.htm).

<sup>103</sup> Hoffman and Kamps.

<sup>104</sup> Ibid.

Training (IFT) for the UAV plus the instrument rating qualification cost to include simulator time. This “out of the box” solution capitalizes on available manpower and is cheaper than using qualified aviators.

Table 10. Cost of Training a B-52 Pilot [From Hoffman and Kamps]<sup>105</sup>

SUPT (fighter/bomber track)	\$392,861
B-52 IQT	+292,190
	<hr/>
Total	\$685,051
<hr/>	
<p><i>Source:</i> Air Combat Command/XOFT. This table uses a B-52 pilot as a valid sample of several Predator pilots, past and present, who maintain the B-52 as their MWS. Also, these figures do not include the cost of B-52 mission qualification training, B-52 requalification training after the Predator tour, survival schools, altitude-chamber training, life-support training, and so forth.</p>	

Table 11. Cost of Training a Non-Pilot for UAV Operation [From Hoffman and Kamps]<sup>106</sup>

IFT	\$5,500
Instrument rating	6,500
Hi-fidelity simulator check	+1,000
	<hr/>
Total	\$13,000
<hr/>	
<p><i>Source:</i> Air Education and Training Command/XOFT. The cost is only \$1,000 if the nonrated selectee already possesses an instrument rating. The table does not include the cost of Predator IQT because a B-52 pilot under the old system would still have to attend Predator IQT; therefore, the cost would be the same.</p>	

<sup>105</sup> Hoffman and Kamps.

<sup>106</sup> Ibid.

### **3. Summary of Selection Criteria**

Navy culture, Fire Scout automation, personnel inventory and training cost are all instrumental in determining the optimum solution to who should operate the RQ-8. The U.S. Air Force has already demonstrated that culture can impede progress and that training personnel with no aviation experience can actually cost less. The Army has successfully demonstrated that it can take trainees directly from high school and make them competent UAV operators after just 21 weeks and two days of instruction at Fort Huachuca.<sup>107</sup> The Fire Scout's advanced automation will provide a larger pool of qualified operators because it will be easier to fly as a result of technology. The Navy must "think outside the box" and address all of these factors thoroughly to determine the optimum manning concept for this new system.

#### **B. VTUAV COMBINED AIR DETACHMENT COMPOSITION**

##### **1. VTUAV Manning Problem**

As stated in Chapter III, the Littoral Combat Ship has limited space for personnel. The maximum threshold is 110 manpower requirements with a target of seventy-five.<sup>108</sup> The embarked air detachment has a significant contribution to this final number. A typical HSL (Helicopter Anti-Submarine Squadron Light) SH-60 air detachment, which consists of two helicopters, has twenty-five manpower requirements. This is the target the Navy would like to achieve for the combined VTUAV air detachment.<sup>109</sup> This threshold is based off the assumption that ships will only have enough available "rack space" for twenty-five additional personnel.<sup>110</sup> The problem is that a combined air detachment with one MH-60 and three Fire Scout air vehicles has thirty-four manpower requirements.<sup>111</sup> The requirement to operate one MH-60 is nineteen and fifteen for three

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<sup>107</sup> Patrick Chisolm. "Learning to Fly...UAVs", [retrieved 8 August 2007] available from World Wide Web @[http://www.military-training-technology.com/print\\_article.cfm?DocID=1256](http://www.military-training-technology.com/print_article.cfm?DocID=1256).

<sup>108</sup> Douangaphaivong.

<sup>109</sup> VTUAV Fleet Integration Manning Brief. 13 June 2003.

<sup>110</sup> Ibid.

<sup>111</sup> Ibid.

Fire Scouts.<sup>112</sup> This is illustrated in Figures 24 and 25, which are both taken from the Fleet Integration Manning brief. In Figure 24 it is assumed that the Mission Commander will also be the AVO. The combined VTUAV air detachment is nine requirements over the threshold and therefore a significant problem the Navy must overcome.

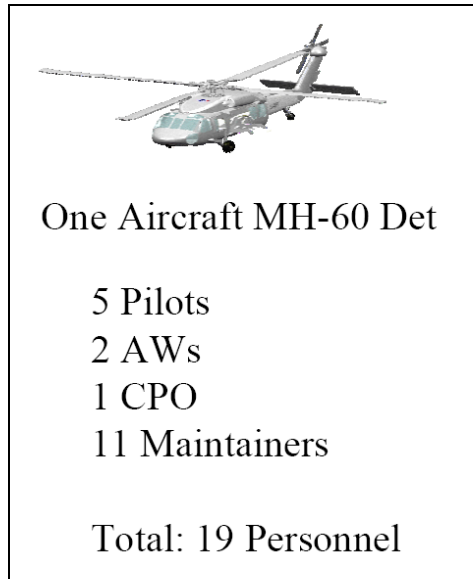


Figure 24. Manpower Requirements for One MH-60 [From VTUAV]<sup>113</sup>

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<sup>112</sup> VTUAV Fleet Integration Manning Brief.

<sup>113</sup> Ibid.

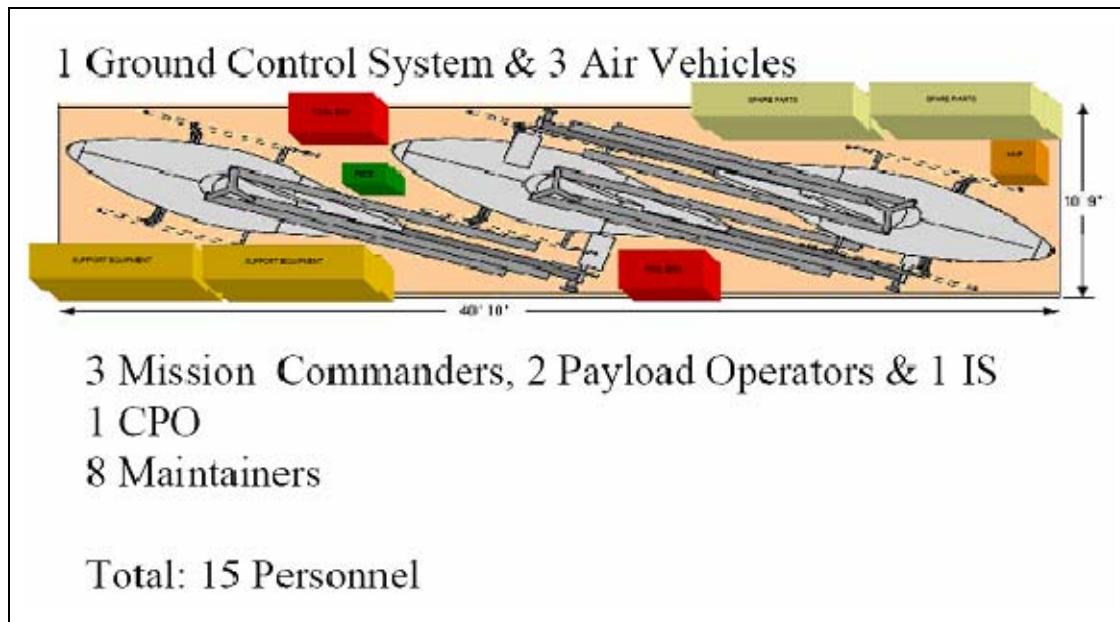


Figure 25. Manpower Requirements for One Fire Scout System [From VTUAV]<sup>114</sup>

This problem was analyzed by NAVAIR, which recently conducted a manpower study for the combined air detachment aboard the LCS. They calculated the impact of operational effectiveness with various manning levels. With an estimated thirty-four manpower requirements for the MIW mission module and thirty for the ASW and SUW mission modules, the risk to operational capability was calculated to be medium.<sup>115</sup> Thaveephone Douangaphaivong, in his Naval Postgraduate School thesis, assumed that the combined air detachment would utilize these numbers within the medium risk category.<sup>116</sup> Table 12 shows the results of the NAVAIR 1.2 LCS Alternative Aviation Support Study, which specifies the operational risk with various manning levels.<sup>117</sup> Even with the medium risk estimates the air detachment minimum threshold is still exceeded by nine and five requirements, respectively.

<sup>114</sup> VTUAV Fleet Integration Manning Brief.

<sup>115</sup> Douangaphaivong.

<sup>116</sup> Ibid.

<sup>117</sup> Ibid.

Table 12. VTUAV Detachment Manning Risk Assessment [From Douangaphaivong]<sup>118</sup>

Type	Manning Level	H-60 Flt Hours Achieved	RQ-8B Flt Hours Achieved	Risk to Meeting Flight Scheduled Events
MIW	57	98	177	LOW
	44	98	177	LOW
	34	83	177	MEDIUM
	28	42	136	HIGH
ASW/SUW	52	110	180	LOW
	40	106	175	LOW
	30	95	175	MEDIUM
	25	50	139	HIGH
	22	50	139	HIGH

## 2. Previously Proposed Solutions

There have been several concepts developed to reduce the combined VTUAV air detachment manpower requirement. Four alternatives were discussed in the Fleet Integration Manning brief. The ideas consisted of decreasing the MH-60 detachment size, dual qualifying the MH-60 personnel, decreasing the VTUAV detachment size and increasing the rack limit aboard ship.<sup>119</sup> Decreasing the size of the MH-60 detachment was considered an unrealistic option because it is a more “capable and complex” helicopter compared to the SH-60.<sup>120</sup> Another option was to dual qualify air detachment personnel to operate the Fire Scout; this was considered a poor option with an already overloaded IDTC (Inter-deployment Training Cycle).<sup>121</sup> The additional training and schooling to provide dual NECs (Navy Enlisted Classification) would be too much. According to the brief, decreasing the VTUAV detachment size is inconclusive because

<sup>118</sup> Douangaphaivong.

<sup>119</sup> VTUAV Fleet Integration Brief.

<sup>120</sup> Ibid.

<sup>121</sup> Ibid.



there is no real-world operational data.<sup>122</sup> However, decreasing the number of air vehicles and/or personnel will undoubtedly have effects on operational capability. This was illustrated in Table 12. Increasing the rack limit, the fourth option, on ships like the LCS is impossible. Therefore, a new and innovative solution needs to be developed to solve this dilemma.

## **C. SURFACE MANNING CONCEPT**

### **1. Surface Ratings vs. Aviation Ratings**

The following question needs to be asked: Why does the U.S. Navy select certain rates for UAV operator eligibility and leave others out? As stated in Chapter II the Navy used the rates of AM, AS, AZ, AT, AW and AE to fill the EP, IP and PO watch-stations for the RQ-2 Pioneer. And according to the VTUAV Navy Training System Plan all enlisted aviation ratings will be eligible to operate the Fire Scout. The strict utilization of aviation ratings does not necessarily mean that operators will be more competent or capable. The U.S. Army has illustrated the fact that it can take brand new soldiers, with zero aviation experience, out of boot camp and properly train them to operate the Hunter and Shadow UAV systems. The argument needs to be made just knowing how to fix and maintain an airframe does not necessarily make you more qualified to operate it. Opening up more rates to fly the VTUAV can have broad implications by alleviating the air detachment manpower requirement aboard LCS as well as increasing the operational capability and flexibility of this new asset. A comparison of eligible and non-eligible rates should be conducted to determine if there is a significant difference in capability regarding the operation of UAVs.

#### ***a. General UAV Operator KSAs***

Because unmanned aerial vehicles are still relatively new and are becoming more technologically advanced everyday, the Federal Aviation Administration (FAA) and U.S. Military are still developing operational standards as well as required

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<sup>122</sup> VTUAV Fleet Integration Brief.

KSAs for operators. Each type of UAV system will require a different set of KSAs and occupational standards based on its respective level of technology, flight automation, control console design and assigned mission. UAS work, such as the MPO and AVO for the Fire Scout, will have varying occupational standards because of the tasks and responsibilities assigned to each Navy occupational classification. Determining the appropriate KSAs and occupational standards will require a detailed analysis that examines UAV control automation, Human Systems Integration (HSI) features, the number of air vehicles to be controlled simultaneously as well as mission tasking, to name a few. In his article “Human Automation Integration for Supervisory Control of UAVs,” Robert Taylor provides a few of the skills that UAV operators will be expected to perform.<sup>123</sup> The following eight tasks he mentions can easily be assigned to a future Fire Scout operator:

- Managing and controlling multiple UAV missions
- Co-ordination and de-confliction of multiple UAV assets
- Interpreting and integrating command strategic intent, ROE and mission control requirements
- Recognizing and dealing with degraded system functionality
- Regaining SA after loss of UAV data links
- Interpreting displays containing multiple UAV perspectives
- Shift of system control to other team members or control stations
- Team-working and interpersonal interaction

***b. Comparison of OS and AZ Occupational Standards***

To specifically examine the validity of having only aviation rates open to VTUAV positions, a comparison will be conducted between an E5 from the AZ, Aviation

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<sup>123</sup> Robert M. Taylor, “Human Automation Integration for Supervisory Control of UAVs” [accessed 3 August 2007] available from World Wide Web @ <http://ftp.rta.nato.int/public/PubFullText/RTO/MP/RTO-MP-HFM-136/MP-HFM-136-12.pdf>.

Maintenance Administrationman rate and an E5 from the OS, Operations Specialist rate. The scope of these ratings is described in the Manual of Navy Enlisted Manpower & Personnel Classifications & Occupational Standards. An overview of the occupational standards of these two jobs will provide the foundation to determine which would potentially be more qualified to operate a Navy VTUAV. Figures 26 and 27 describe the scope of these occupations and are taken from the Manual of Navy Enlisted Manpower & Personnel Classifications & Occupational Standards.

Operations Specialists (OS) function as Plotters, Radiotelephone, and Command and Control internal communications talkers; maintain Combat Information Center (CIC) displays of strategic and tactical information; operate surveillance radars, Identification Friend or Foe (IFF) Systems, and associated equipment; interpret radar presentations, evaluate tactical situations, and make recommendations to superiors during watch conditions; apply current doctrine and procedures to CIC operations as specified by U. S. Navy Instructions and Joint/Allied/U. S. Navy publications; and apply current doctrine and procedures to radar navigation; provide technical information and assistance during Surface Warfare, Air Warfare, Submarine Warfare, Amphibious Warfare, Mine Warfare, Naval Surface Fire Support, and Search and Rescue operations; provide technical information and advice on capabilities, limitations, reliability, and operational readiness.

Figure 26. Scope of Operations Specialist Rating [From Bureau of Naval Personnel]<sup>124</sup>

Aviation Maintenance Administrationmen (AZ) perform technical, managerial, and support duties required by the Naval Aviation Maintenance Program; prepare aircraft and maintenance related correspondence; maintain directive control and custody records, control forms and reporting requirements; maintain files on departmental organization, manning, personnel TAD and transfers, and training requirements; plan, program, and coordinate scheduled and unscheduled maintenance tasks and the incorporation of changes and modifications on/to aircraft and aeronautical equipment and support equipment; coordinate squadron/activity maintenance reporting requirements and recommend changes to maintenance policies and procedures; organize, maintain and operate Navy Aeronautical Technical Publications Library, oversee dispersed libraries, audit and train dispersed librarians; operate the Naval Aviation Logistics Command Management Information System (NALCOMIS); input, verify, and validate data pertaining to the history, operation, maintenance, configuration, receipt, and transfer of naval aircraft, related aeronautical equipment, and components installed in those equipment; maintain operations department flight data historical files and aviator data; provide support/assistance to organizational, intermediate, and depot maintenance staff areas; and perform other duties, as required, when attached to organizational, intermediate, and depot maintenance activities or aviation staff commands.

Figure 27. Scope of Aviation Maintenance Administrationman Rating [From Bureau of Naval Personnel]<sup>125</sup>

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<sup>124</sup> Bureau of Naval Personnel, Navy Enlisted Occupational Standards Volume I. NAVPERS 18068F.

<sup>125</sup> Ibid.

The comparison of occupational standards between these two ratings does not illustrate any clear advantage an AZ2 would have over an OS2 in flying a Navy VTUAV, especially when compared to the Robert Taylor list. The occupational standards listed in Appendix A are by functional area for an OS2 taken from the Manual of Navy Enlisted Manpower & Personnel Classifications & Occupational Standards.<sup>126</sup> The occupational standards listed in Appendix B are by functional area for an AZ2 taken from the same manual.<sup>127</sup> It is abundantly clear from just a cursory review of the different occupational standards that the AZ2 rating is primarily administrative in function regarding technical publications, maintenance and logs. These skills are important but not related to the control aspect of operating a VTUAV. The OS2 rating is also unrelated to the control features of such a platform. However, it can be effectively argued that the OS2 will have a stronger understanding of the operations that the Fire Scout will be supporting. The occupational standards comparison alone makes an effective argument that the OS2 will understand MIW, SUW and ASW operations far more than an AZ2. The AZ2 will undoubtedly have a stronger knowledge of the actual air-frame and maintenance requirements of the air vehicle but not of its real-world, tactical applications. To illustrate the point further the Operations Specialist Navy Enlisted Classification code (NEC) of OS-0234 ASW/ASUW Tactical Air Controller, known as an (ASTAC), has the following job description illustrated in Figure 28.

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<sup>126</sup> Bureau of Naval Personnel, Navy Enlisted Occupational Standards Volume I. NAVPERS 18068F.

<sup>127</sup> Ibid.

**OS-0324 ASW/ASUW Tactical Air Controller (ASTAC)**

Operates the LAMPS MK-III weapons system and OJ-194 NTDS consoles. Controls and directs the communications, overall tactics, sensor information correlation and integration, flight safety, sonobouy, and data link operations of ASW/ASUW aircraft.

Source Rating: OS	Billet Paygrades: E5-E9	Personnel Paygrades: E5-E9
Course: Mandatory	CIN: K-221-2503	
Sequence Code: 3		CDP: 743B, 586X
Component NEC:	Related NEC:	NR Ind: N
Primary Advisor: CNO	Technical Advisor:	Open to Women: Yes
N865	NAVSEA	ECM: PERS 4011D5

NOTE: Personnel who have maintained their Air Controller proficiency as an ASTAC will continue to receive SDAP at the OS-0324 level as prescribed in BUPERS NAVADMIN.

Figure 28. OS-0324 NEC Description [From Bureau of Naval Personnel]<sup>128</sup>

An OS with 0324 NEC controls Navy aircraft in order to integrate them properly in a tactical scenario, like an ASW mission. The only major difference between this and operating a Fire Scout on an ASW mission is the fact that the aircraft controlled is manned. The NEC OS-0324 would clearly be a better fit as a VTUAV Operator. There is no advantage the AZ2 skill set has when compared to the OS2 skill set for flying a Navy VTUAV. It can be argued that the OS2 has the advantage of operational and tactical knowledge by occupation and career development.

***c. Recommendation***

The U.S. Navy should not rely only on aviation rates to man the new MQ-8B Fire Scout UAV. It is clear that an AZ, other than being affiliated with aviation, provides no significant advantages regarding the control of a VTUAV. On the other hand, an OS does offer very relevant experience and operational expertise regarding Fire Scout mission tasking. The AZ rate, as well as the other eligible aviation rates, have shown to be adequate in operating the RQ-2 Pioneer and will more than likely do the same for the Fire Scout. However, to completely discount other rates because they are

<sup>128</sup> Bureau of Naval Personnel, Navy Enlisted Classifications Volume II. NAVPERS 18068F.

not associated with aviation is detrimental and inefficient. The AZ and OS comparison reveals that a cultural dynamic that precludes all non-aviation rates for no rational reason may exist. This appears to be the case when a surface rating makes a better fit to operate this new VTUAV system but is ineligible. A similar argument could be made regarding the Mission Commander position. Why preclude Surface Warfare Officers (SWO) who are Tactical Action Officer (TAO) qualified? These officers are tasked with utilizing all available assets to “fight the ship”. The Navy should rethink its UAV manning concept and look beyond aviation rates for qualified operators.

## **2. Surface Manning Concept Expanded Capability and Training**

### ***a. LCS Watch Standing Implications***

The surface manning concept would relieve the manpower problem for the combined air detachment aboard the Littoral Combat Ship. Allowing non-aviation rates, from different mission modules or the core crew, to attend VTUAV training would maximize the amount of qualified operators onboard. This could reduce the manpower requirement for the combined air detachment by dual qualifying non-aviation personnel. An example of this would be to entirely remove the three mission commander requirements as well as the three enlisted operator requirements from the Fire Scout detachment illustrated in Figure 25. In place of these personnel, dual qualify three Surface Warfare Officers, three surface enlisted personnel, three MH-60 pilots as well as three enlisted aviation personnel from the helicopter air detachment as illustrated in Table 13.

Table 13. Dual Qualification Six Section Fire Scout VTUAV Watch Rotation

<b>Six Section Fire Scout UAS Watch Rotation</b>	
<b>Personnel Comprising Six Watch Teams</b>	<b>Hours of Watch</b>
1 SWO + 1 Enlisted Surface Rate	4 Hours
1 SWO + 1 Enlisted Surface Rate	4 Hours
1 SWO + 1 Enlisted Surface Rate	4 Hours
1 MH-60 Pilot + 1 Enlisted Aviation Rate	4 Hours
1 MH-60 Pilot + 1 Enlisted Aviation Rate	4 Hours
1 MH-60 Pilot + 1 Enlisted Aviation Rate	4 Hours
<b><i>Manpower Requirements absorbed from LCS and MH-60 detachment.</i></b>	<b><i>24 Hours Continuous Flight Operations</i></b>

This example illustrates the potential for maximizing watch-standing time while simultaneously reducing the manpower requirement by six. This is obviously an over simplification and contradicts the previously mentioned decision not to dual qualify MH-60 personnel. However, it is possible that dual qualifying only three of the five MH-60 pilots would not stress the IDTC as much as originally estimated because every pilot would not be required to attend VTUAV training. All twelve VTUAV watch-standers will also be able to stand four hours of watch conducting their traditional duties in the same twenty-four-hour cycle, this equates to a total of eight hours of watch per day. This is in accordance with the Navy Standard Workweek. For example, a Surface Warfare Officer could stand four hours of bridge watch as an OOD (Officer of the Deck) and eight hours later stand a four-hour VTUAV MC watch. The details of removing six manpower requirements from the Fire Scout detachment are highly complex and beyond the scope of this analysis; however it illustrates the potential for optimizing the manning of the Fire Scout system by allowing non-aviation rates to qualify for VTUAV training.

***b. Surface Combatant and Operational Implications***

The surface-manning concept can also expand the operational capability of the Fire Scout UAS. If every air-capable ship in the fleet has qualified VTUAV operators then the operational capacity of such a system could be greatly enhanced. The TCS hardware discussed in Chapter III will allow surface ships, outside of LCS, the ability to control Fire Scout air vehicles. This could profoundly impact the operational range, refueling aspects, emergency procedures as well as tactics of the Fire Scout by having ships throughout the fleet act as “lily pads.” The capability and versatility of the Fire Scout UAS could surpass the Navy’s initial expectations by having qualified, non-aviation personnel aboard surface vessels qualify as VTUAV operators.

***c. Surface Manning Concept and Training Implications***

The Navy must develop an adequate school house capable of training the large number of operators necessary to institute the surface manning concept. Not every ship in the fleet will require VTUAV operators and not every air-capable ship that serves as a “lily pad” will require a total of three Mission Commanders/Air Vehicle Operators and three Payload Operators. However, this analysis will calculate the manning requirements to train three Mission Commanders/Air Vehicle Operators and three Payload Operators for every air-capable ship in the fleet, not including aircraft carriers or LCS. It will also calculate the minimum, which is one watch stander for each VTUAV position for every ship. These estimates may provide numbers that far exceed the maximum quantity of personnel the Navy would want to train as operators as shown in Table 14. This is purely to illustrate the Navy’s need to institute a serious training curriculum and pipeline just to institute a fraction of the surface-manning concept.



Table 14. Surface Manning Concept Initial Training Numbers

Air Capable Ship Classes	Number of Ships in Class	Number of Trainees	
		(6 per ship)	(2 per ship)
<b>CG</b>	22	132	44
<b>DDG</b>	58	348	116
<b>FFG</b>	30	180	60
<b>LHD</b>	8	48	16
<b>LPD</b>	15	90	30
<b>LSD</b>	8	48	16
<b>Total Training Requirement:</b>		<b>846</b>	<b>282</b>

#### D. SUMMARY

The Navy should not preclude non-aviation personnel from operating the Fire Scout VTUAV. At a minimum, the Navy should thoroughly investigate this option, which has the potential for maximizing the Fire Scout's versatility while simultaneously lowering the combined VTUAV air detachment's manning number. Specifically, the Navy needs to identify the occupations best qualified to operate this new platform regardless of previous cultural norms. It needs to make an objective assessment as to which personnel have the prerequisite knowledge and capability to attend VTUAV training and become competent operators. This analysis will have to consider the training costs for obtaining the required number of qualified personnel. It will also need to thoroughly look at the impact of dual qualifying shipboard personnel as well MH-60 detachment personnel. Lastly, the implications of the surface-manning concept on enhancing the versatility and capability of the Fire Scout should not be overlooked. If the Navy does not conduct a thorough job and needs analysis for the surface manning concept it may be overlooking a viable option for optimally manning both LCS and the RQ-8B UAS.

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## **V. SUMMARY, CONCLUSION AND RECOMMENDATIONS**

### **A. SUMMARY**

This research examined the manpower requirements for the MQ-8B Fire Scout VTUAV and the Navy and Marine Corps manpower requirements for the RQ-2 Pioneer and the Army RQ-7 Shadow. The examination provided a framework for understanding the operations, missions and watch stations required for operating military UAVs. The Littoral Combat Ship's mission modules were analyzed to determine how Fire Scout would be incorporated in supporting the ship's primary missions. An overview of LCS baseline manning constraints were examined as they relate to the air component. Finally an analysis of the KSAs as denoted in occupational standards between two rates, AZ and OS, to operate VTUAVs was conducted. This comparison revealed no significant difference in capability of the eligible aviation rating over the ineligible surface rating. In summary, it was discovered that the Navy's current policy and standards could be an impediment to the optional manning requirements of LCS. A change to the source rating of NEC 8363 and 8364 could relieve the optimal manning dilemma for the combined VTUAV air detachment. It also could expand the operational capability and flexibility of the Fire Scout. In conclusion, the Navy should, at a minimum, conduct a detailed analysis for how it can best operationally man this new platform.

### **B. CONCLUSIONS AND RECOMMENDATIONS**

#### **1. Primary Research Questions**

##### ***a. What is the Composition of UAV Watch Teams?***

**Conclusion:** UAV watch teams throughout the U.S. military are very similar in composition. Every UAV system essentially contains the same types of watch stations to include a Mission Commander, a UAV Pilot as well as a UAV Payload Operator. However, each branch uses slightly different names and combines some

positions like the External Pilot and Internal Pilot into one watch station. Specifically, the Marine Corps combined the Internal Pilot job and Payload Operator job into one position called the System Operator for the Pioneer UAS. The Army also combined the External Pilot and Internal Pilot job into one position known as the Vehicle Operator, here there is no distinction between an external pilot and internal pilot. Also some branches have one MOS to conduct multiple UAV jobs. For example, the Army has combined the Payload Operator (PO) position, the Internal Pilot (IP) position and the External Pilot (EP) position into one Military Occupation Specialty (MOS) of 96U. The Navy has a separate NEC for each position for the Pioneer UAS. Therefore there is a separate NEC and AQD for the Mission Commander, External Pilot, Internal Pilot as well as Payload Operator. The Fire Scout VTUAV is to be manned by a Mission Commander, Air Vehicle Operator and Mission Payload Operator.

***b. What are the Existing Operations and Future Operations of Naval VTUAVs?***

**Conclusion:** The Naval VTUAV, or Fire Scout UAS, will be performing all of the missions and operations of its predecessor, the RQ-2 Pioneer. The Fire Scout will be performing missions to include gathering ISR imagery, providing communications relay capability, obtaining battle damage assessment information as well as supplying precision targeting information. It will also be given target neutralization capability through the installation of rocket pods as well as Hellfire II laser-guided missiles. The Fire Scout VTUAV is still in the beginning stages of being integrated to the fleet and will therefore continue to develop operationally.

**Recommendation:**

- Provide the technology to Navy ships to increase fleet capabilities to include the Fire Scout VTUAV. The operational capability and flexibility for this platform can provide greater capability to not only LCS but to the strike-group with the appropriate TCS hardware and

software. At a minimum, the concept of “lily pad” would provide persistent on station time as well as improved emergency procedures for the Fire Scout.

*c. What Current Manpower Requirements Support Fire Scout VTUAV Mission Commanders, Payload Operators and Vehicle Operators?*

**Conclusion:** The Navy VTUAV NTSP dated June 2001 shows that only aviation enlisted ratings are eligible to qualify for VTUAV operator training. This includes all aviation rates between E-5 and E-7. The research also shows that only aviation officers, 13XX designator, are eligible to perform the duties of Mission Commander. These are the existing personnel that are currently available to operate the VTUAV. The notion of autonomous flight versus remotely piloted flight plays a role in the occupational flexibility of this change in philosophy.

**Recommendations:**

- Navy Enlisted Occupational Standards Volume I shows that the OS rating is just as qualified, per the occupational standards, to perform the 8363 (Internal Pilot) and 8364 (Payload Operator) functions as an AZ. Therefore it is recommended that the Navy revise NECs 8363 and 8364 immediately to include Operations Specialist as a new source rating. This is made with the assumption that the Navy will utilize these NECs for the Fire Scout as it did for the Pioneer. Appendix A is a template for initiating a new source rating, OS, for the NECs of 8363 and 8364 for review by the NEOCS (Navy Enlisted Occupational Classification System) Board.
- Examine other ratings that should be considered as source ratings for NEC 8363 and 8364.

## 2. Secondary Research Question

### a. *What are the Existing Occupational Standards for VTUAV and UAV Operators in the U.S. Navy?*

**Conclusion:** Due to the relative infancy of UAVs and VTUAVs the KSAs and occupational standards required to operate these platforms require further development. The complexity and variety of UAVs make this a challenging task for both the civilian and military sectors. The research showed no evidence that the Navy has conducted an appropriate needs analysis in this area.

#### **Recommendation:**

- Generate a list of KSAs required to operate the Fire Scout. This list should capture the Mission Commander, AVO and MPO positions. This will provide the best foundation for how to establish occupational standards to operate the Fire Scout VTUAV.
- Establish an Officer AQD for Mission Commander.

## C. AREAS FOR FURTHER RESEARCH AND STUDY

- Conduct a cost analysis for installation of TCS on other Navy vessels.
- Conduct a study to determine where a major UAV and VTUAV training facility should be established. This study should examine if current schools and infrastructure are adequate to provide the quality and quantity of training necessary to fully implement the Fire Scout VTUAV.
- Establish procedures and tactics for the Fire Scout VTUAV to include MIW, SUW and ASW operations. This should also include specific command and control procedures between different platforms, take-off and landing checklists, emergency procedures as well as refueling guidelines.

## **APPENDIX A. OS2 OCCUPATIONAL STANDARDS**

### **B. AIR WARFARE**

- B059 MONITOR RETURN TO FORCE (RTF) ASSETS
- B060 DETERMINE SURVEILLANCE OF ASSIGNED AIR WARFARE (AW) AREAS
- B061 DETERMINE ENGAGEABILITY OF ASSIGNED AIR WARFARE (AW) AREAS

### **C. UNDERSEA WARFARE**

- C097 RECOMMEND AND IMPLEMENT UNDERSEA WARFARE (USW) SEARCH AND ATTACK PLANS
- C109 RECOMMEND SEARCH AND ATTACK UNIT (SAU) APPROACH TO DATUM
- C373 OBTAIN UNDERSEA WARFARE (USW) INTELLIGENCE FOR ANALYSIS
- C403 REVIEW UNDERSEA (USW) OPERATIONAL TASKS (OPTASKS) AND ASSOCIATED MESSAGES

### **D. SURFACE WARFARE**

- D129 COORDINATE SURFACE WARFARE (SUW) AND ANTI-SHIP MISSILE DEFENSE (ASMD)

### **I. ELECTRONIC SYSTEMS OPERATIONS**

- I415 OPERATE IMBEDDED TRAINING DEVICES

### **J. COMMUNICATIONS**

- J418 DRAFT TRAINING REPORTS (TRAREPS)

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## APPENDIX B. AZ2 OCCUPATIONAL STANDARDS

### B. MAINTENANCE MANAGEMENT AND SUPERVISION

- B077 VALIDATE AIRCRAFT AND EQUIPMENT MAINTENANCE SCHEDULES
- B088 ASSEMBLE PRE-INSPECTION MEETING DOCUMENTS AND PLANS
- B089 PREPARE AIRCRAFT SERVICE PERIOD ADJUSTMENT/INTEGRATED MAINTENANCE CONCEPT (IMC) REPORTS
- B091 PREPARE CHANGE OF LOCATION ACTIVITY REPORTS
- B092 FURNISH INFORMATION AND ADVICE ON MAINTENANCE DATA REPORTS
- B094 PREPARE PLANNER AND ESTIMATING (P&E) REQUESTS
- B105 PREPARE AIRCRAFT MATERIAL READINESS REPORTS (AMRR)
- B112 TRACK RELIABILITY CENTERED MAINTENANCE (RCM) SCHEDULES
- B113 TRACK STRUCTURAL APPRAISAL OF FATIGUE EFFECTS REQUIREMENTS
- B114 ANALYZE SERVICE LIFE EXTENSION PROGRAM (SLEP) REQUIREMENTS
- B115 DETERMINE TOUR PERIOD END DATE OF NAVAL AIRCRAFT

### C. MAINTENANCE/PRODUCTION CONTROL

- C122 VERIFY RECORDS WITH ORGANIZATIONAL EQUIPMENT REMOVED FOR TRANSFER/REWORK
- C123 VERIFY AND REPORT MISSION EQUIPMENT FOR AIRCRAFT TRANSFERRED
- C124 VERIFY AND REPORT MISSION EQUIPMENT MISSING FROM AIRCRAFT RECEIVED
- C125 SUBMIT AIRCRAFT DISCREPANCY REPORTS (ADR)
- C130 VERIFY INVENTORY RECORDS WITH WEIGHT AND BALANCE RECORDS
- C146 COMPILE INPUT DATA FOR MAINTENANCE PLANS
- C157 PREPARE TIME TRACKING RECORDS FOR HOT SECTION INSPECTION AND ENG RUN-UPS
  
- C162 VALIDATE NAVAL AIRCRAFT FLIGHT RECORD (NAVFLIR) EXCEPTION CODES WITH OPERATIONS
- C209 VERIFY WARRANTY INFORMATION
- C224 UPDATE SCHEDULES FOR INDIVIDUAL AVIATION LIFE SUPPORT SYSTEM (ALSS) GEAR
- C230 COMPARE MASTER AIRCRAFT LIST WITH AIRCRAFT INVENTORY RECORDS
- C231 INPUT WEIGHT AND BALANCE DATA INTO RECORDS
- C232 REVIEW SHORTAGE ITEMS AIRCRAFT RECORDS
- C337 TRACK TECHNICAL DIRECTIVE (TD) SUPPLY STATUS

### D. LOGS AND RECORDS

- D106 PREPARE FLIGHT LOADS, LAUNCH AND LANDING DATA REPORTS
- D120 SUBMIT STANDARD DEPOT LEVEL MAINTENANCE (SDLM) SPECIAL WORK REQUESTS
- D239 RECORD ONE TIME AND EXPERIMENTAL AIRCRAFT MODIFICATIONS
- D251 VERIFY AIRCRAFT, ENGINE AND COMPONENT FLIGHT HOURS
- D255 VERIFY AIRCRAFT, ENGINE AND COMPONENT OPERATING CYCLES
- D263 REVIEW AERONAUTICAL EQUIPMENT SERVICE RECORD (AESR) FORMS
- D267 VERIFY MODULAR SERVICE RECORDS (MSR)
- D273 VERIFY ASSEMBLY SERVICE RECORDS (ASR)
- D277 REBUILD AIRCRAFT/EQUIPMENT HISTORY FOR LOST OR DESTROYED RECORDS
- D283 VERIFY INSTALLED COMPONENTS AND ACCESSORIES DATA
- D284 VERIFY EXPLOSIVE DEVICE LOT/CARTRIDGE NUMBERS REPORTED IN LOGS/RECORDS
- D285 SCREEN TECHNICAL DIRECTIVES (TD) FOR APPLICABILITY
- D286 COMPLY WITH TECHNICAL DIRECTIVE (TD) REQUIREMENTS
- D287 ORDER TECHNICAL DIRECTIVE (TD) KITS
- D289 MONITOR COMPLIANCE WITH TECHNICAL DIRECTIVES (TD) ON AIRCRAFT AND EQUIPMENT

D292 VERIFY PREVIOUS TECHNICAL DIRECTIVE (TD) COMPLIANCE ON NEWLY RECEIVED EQUIPMENT  
 D293 UPDATE TECHNICAL DIRECTIVE STATUS ACCOUNTING (TDSA) PROGRAM LISTS AND REPORTS (LISTS 2, 4, 4H)  
 D302 UPDATE AND VERIFY AIRCRAFT LOGBOOKS UPON TRANSFER/RECEIPT  
 D303 UPDATE AND VERIFY AERONAUTICAL EQUIPMENT SERVICE RECORDS UPON TRANSFER/RECEIPT  
 D304 UPDATE AND VERIFY EQUIPMENT/COMPONENT RECORD CARDS UPON TRANSFER/RECEIPT  
 D305 VERIFY INVENTORY OF AIRCRAFT UPON RECEIPTS/TRANSFERS  
 D306 VERIFY TYPE EQUIPMENT INVENTORY UPON RECEIPTS/TRANSFERS  
 D313 PROVIDE INFORMATION FROM LOGS AND RECORDS FOR THE NAVAL AVIATION MAINTENANCE DISCREPANCY REPORTING PROGRAM (NAMDRP)  
 D316 DISPOSE OF AIRCRAFT LOGBOOKS, AERONAUTICAL EQUIPMENT SERVICE RECORD (AESR) AND COMPONENT RECORDS  
 D319 CONSOLIDATE MAINTENANCE DATA SYSTEM DETACHMENT REPORTS  
 D552 DISPOSE OF AIRCRAFT HISTORY FILES  
 D554 DISPOSE OF LIFE LIMITED COMPONENT RECORDS  
 D556 PURGE AIRCRAFT HISTORY FILES  
 D557 ACCESS THE INTERNET FOR AVIATION TECHNICAL INFORMATION

#### E. TECHNICAL PUBLICATIONS LIBRARY

E225 UPDATE AVIATION LIFE SUPPORT SYSTEM (ALSS) TECHNICAL DIRECTIVES (TD) FOR INDIVIDUAL FLIGHT GEAR  
 E322 MAINTAIN AUTOMATED LIBRARY TECHNICAL MANUAL SYSTEM  
 E324 REQUEST INITIAL OUTFITTING LISTS  
 E325 MAINTAIN AUTOMATIC DISTRIBUTION REQUIREMENTS LISTINGS (ADRL)  
 E326 CORRECT AUTOMATIC DISTRIBUTION REQUIREMENTS LISTINGS (ADRL) ERRORS  
 E327 VERIFY CURRENT DATABASE WITH PUBLICATIONS  
 E328 AUDIT DISPERSED LIBRARIES  
 E330 VERIFY WEEKLY SUMMARY OF ISSUED TECHNICAL DIRECTIVES (TD)  
 E331 MAINTAIN TECHNICAL PUBLICATION LIBRARY INFORMATION SHEETS (TPLIS)  
 E334 MAINTAIN TRANSACTION FILE  
 E335 ORDER PUBLICATIONS, FORMS, DIRECTIVES AND TECHNICAL DIRECTIVES (TD)  
 E340 MAINTAIN TECHNICAL DIRECTIVE (TD) MASTER FILES  
 E341 UTILIZE MILITARY STANDARD REQUISITION AND ISSUE PROCEDURES (MILSTRIP) DESK GUIDE  
 E345 RECEIVE, UPDATE AND DISTRIBUTE CLASSIFIED PUBLICATIONS  
 E347 VERIFY MONTHLY INTERIM RAPID ACTION CHANGE (IRAC) AND TRACKER  
 E351 SUBMIT TECHNICAL PUBLICATION DEFICIENCY REPORTS  
 E355 ISSUE AND TRACK CHANGE ENTRY CERTIFICATION RECORDS  
 E356 UPDATE AND CORRECT TECHNICAL PUBLICATIONS REQUISITION DATA  
 E358 CONDUCT TRAINING FOR DISPERSED LIBRARIANS  
 E361 PREPARE LOCAL MAINTENANCE REQUIREMENTS CARDS (MRCS)  
 E364 AUDIT CENTRAL LIBRARY  
 E365 SUBMIT LIBRARY SHORTAGES AUTOMATED DISTRIBUTION REQUIREMENTS LISTS (ADRL)  
 E370 ISSUE FORMAL AND INTERIM CHANGE BULLETINS FOR CD ROM PUBLICATION  
 E371 VALIDATE CHANGE INCORPORATION TO CDROM UPON REISSUE  
 E372 ORDER, UPDATE AND FILE DEPARTMENT OF DEFENSE (DOD) AND MANUFACTURER PUBLICATIONS/SERVICE BULLETINS/DIGESTS AND PERIODICALS NOT UNDER ADRL  
 E373 VERIFY NAVAL AERONAUTICAL PUBLICATIONS INDEX (NAPI)/NAVAL LOGISTICS LIBRARY (NLL) FOR AIRCRAFT AND EQUIPMENT APPLICATION  
 E558 RECEIVE, ISSUE AND INCORPORATE INTERIM RAPID ACTION CHANGE (IRAC)  
 E559 ACCESS THE INTERNET FOR AVIATION PUBLICATIONS

G. NAVAL AVIATION LOGISTICS COMMAND MAINTENANCE INFORMATION  
SYSTEM (NALCOMIS) MANAGEMENT/AUTOMATED DATA PROCESSING (ADP)

- G320 COORDINATE MAINTENANCE DATA SYSTEM DETACHMENT TRAINING
- G321 PREPARE DETACHMENT REQUIRED RECORDS, REPORTS AND PERSONNEL DATA
- G384 UTILIZE ADHOC REPORTS AND INQUIRIES
- G399 SUBMIT TROUBLE REPORTS/CHANGE PROPOSAL TO NAVAL AVIATION LOGISTICS  
COMMAND MAINTENANCE INFORMATION (NALCOMIS) SYSTEMS AND  
TECHNICAL MANUALS
- G405 REVIEW NAVAL AVIATION LOGISTICS COMMAND MAINTENANCE INFORMATION  
(NALCOMIS) SYSTEM MAILBOXES/QUES
- G406 APPROVE NAVAL AVIATION LOGISTICS COMMAND MAINTENANCE INFORMATION  
(NALCOMIS) MAILBOXES/QUES
- G423 REVIEW, ORDER AND STOCK FORMS AND AUTOMATED DATA PROCESSING (ADP)  
MATERIALS

I. TECHNICAL MANAGEMENT

- I513 VERIFY AND UPDATE SURVIVAL EQUIPMENT ASSET TRACKING SYSTEM/INCREASED  
CAPACITY (SEATS/ICAP)
- I516 CORRECT AIRCRAFT ENGINE MANAGEMENT SYSTEM ERRORS (AEMS)

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## APPENDIX C. SOURCE RATING REQUEST TEMPLATE

1221  
Ser

From: Name of activity submitting approval

To: Commanding Officer, Navy Manpower Analysis Center (Code 10), NSA  
Memphis, Millington, TN 38054

Via: Chain of Command

Subj: PROPOSAL TO ESTABLISH A NEW SOURCE RATING FOR NEC 8363  
AND NEC 8364

Ref: (a) NAVPERS 18068F, Volume II (NECs)  
(b)

1. Request establishment of a new source rating for NEC 8363 and 8364 per  
reference (a).

a. NEC Codes and titles:

- i. 8363, Unmanned Aerial Vehicle (UAV) Internal Pilot
- ii. 8364, Unmanned Aerial Vehicle (UAV) Payload Operator

b. Sequence Code: 3 for both 8363 and 8364

c. Description:

- i. 8363, Operates and navigates UAV during the enroute, mission,  
and return phase of flight.
- ii. 8364, Operates EO/IR UAV sensor during all phases of flight.

d. Current Source Ratings:

- i. 8363: AS, AM, AE, AT, AZ, AW
- ii. 8364: AS, AM, AE, AT, AZ, IS

e. Component NEC: N/A

f. Related NEC: N/A

g. Cost Analysis:

$$\text{MPN} = (\text{course length in days} * \text{number of students}) / 360$$

$$\text{Approx follow-on} = \text{MPN} / 3$$

\*\*\*This will be determined by the length of training for the Fire Scout VTUAV.

However, the current courses of CIN: C-104-0642 for NEC 8363 and CIN: C-104-0643 for NEC 8364 are for Pioneer training.

- h. Training:
  - (1) The NEC will be awarded through formal training.
  - (2) The courses CIN: C-104-0642 and CIN: C-104-0643 are currently engineered for the RQ-2 Pioneer, not the Fire Scout.
- i. Number of Billets: 282 to 846, referenced in Chapter Four.
- j. Personnel Paygrade: E5-E7
- k. Billet Paygrade: E5-E7
- l. Special Qualifications: N/A
- m. Skill Identification: N/A
- n. Assignment: Open
- o. Inactive Duty Select Reservists: N/A
- p. Endorsements:
- q. Directives: U.S. Navy. Navy Training System Plan for the Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle, Vertical Take-Off and Landing Tactical Unmanned Aerial Vehicle (VTUAV) Concept of Employment (COE) DRAFT G, Draft Navy Training System Plan for the Pioneer Unmanned Aerial Vehicle System. Vol. N88-NTSP-A-50-8622D/D, NATOPS Flight Manual Navy Model RQ-2B Pioneer Unmanned Aerial Vehicle. Vol. A1-RQ2BA-NFM-000.
- r. Justification: The proposal to add the Operations Specialist rating as a source rating for the NECs 8363 and 8364 is to increase the available pool of qualified personnel to train for Fire Scout VTUAV operator positions. This will alleviate manning constraints as well as increase operational flexibility; this is referenced in Chapter Four.
- s. Platform/Equipment: MQ-8B Fire Scout VTUAV
- t. Point of Contact:
- u. Occupation Standards:

v. Workload Measurements:

\*\*\*Specific instructions for completing this template in its entirety can be found in the Enlisted Occupational Standards Volume I, NAVPERS 18068F.

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